Electrical Review

With Which Is Consolidated WESTERN ELECTRICIAN and ELECTROCRAFT.

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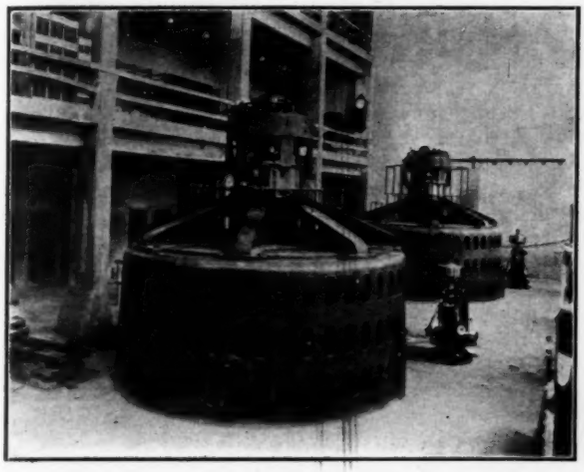
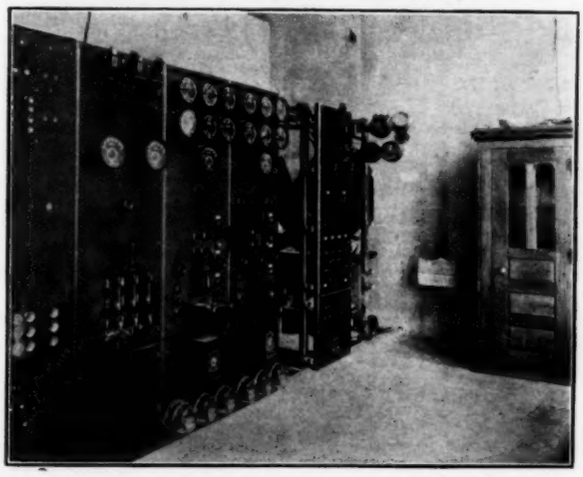


Operating Floor of Station No. 5, Showing Two Generators Nearly Completed.



Generator End of Switchboard, Showing Panels for Spare Exciter, Generator No. 1, Generator No. 2.

New Station No. 5 of the Rochester Railway & Light Company

Hydroelectric Generating Station of 32,000 Horsepower Operated to Carry the Load Peaks of Combined System

By P. B. FINDLEY

A CONSOLIDATION for power purposes of two falls in the Genesee River and the securing of maximum pondage are the reasons that led to building the new 25,000-kilovolt-ampere hydroelectric generating station of the Rochester (N. Y.) Railway & Light Company. Located in the bottom of the gorge, within a few feet of the level of Lake Ontario, the two 16,000-horsepower turbines of this station convert into electricity the power of a 130-foot drop.

The fundamental design of the new station is of special interest because of its place in a system of whose needs it supplies only about 40 per cent. The Rochester system is a combination of water and steam plants tied in by transmission lines with power stations at Niagara Falls and elsewhere. On account not only of the rapidly growing load on the system, but of the impending curtailment of Niagara power, it was evident several years ago that every foot of water in the Genesee River must be utilized.

Location and General Scheme of Station.

A study of the topography of the river showed that the most fruitful point of attack was at the lower reaches. Here there are two drops of about 40 feet and 90 feet, respectively. Above the upper one is a reach about 1.5 miles long in which 23,000,000 cubic feet of water can be stored, the limitation being the allowable water level near factory sites at the upper end. It was considered that the most economical development was one which would in seasons of low water empty this pondage during each day. Thus the hydroelectric station would take the top off the daily peak, allowing the steam plants to operate at a higher load-factor and hence more economically. A theoretical daily cycle of operation is shown on the next page; the shaded area of the system load curve represents the power generated by the new hydro station. Obviously, when the hydroelectric units are shut down, no power is being wasted in standby losses, as in a steam plant with banked fires.

With the present water situation, it was decided that the economic capacity of the falls was 32,000 horsepower, with the possibility of an increase to 48,000 horsepower at a later date. Accordingly, plans were drawn which covered the installation of two 16,000-horsepower turbines, with provision for a third, and the removal of all present generating equipment at both upper and lower falls. Until the final unit is

Interior of Tunnel at Lower End Where It Merges Into the Three Penstocks.

installed, however, the present apparatus of 6000-kilowatt capacity at the lower falls will remain, to be used in times of high water when there is flow to spare—about three months a year.

As has been said above, the height of water in the storage pond is limited by factory sites adjacent to its upper end. Since the gradient of the river bed in this stretch is very slight, it was necessary to design a dam which should offer the minimum obstruction to flow during flood seasons, in order to prevent the water from backing up and overflowing the lands near the upper end of the reach. Consequently, a dam which can be entirely removed from the channel was determined upon.

Dam and Gate Construction.

The dam contains two Taintor gates each 50 feet long, at each side. Adjacent to these are two 100-foot sector gates, and in the center is the headhouse covering the tunnel intake. The Taintor gates can be raised clear of the water, while the sector gates can be lowered into pits in the river bed, giving an entirely unobstructed passage amounting to 83 per cent of the width of the channel. Ordinarily any adjustment of pool level will be made by the sector gates. These are hollow forms of structural steel, having but two surfaces, a plane top and a cylindrical face, making an approximately water-tight joint with the edges of concrete pits into which they recede. Each gate is hinged about a horizontal axis at its downstream edge, this axis being the center of curvature of the cylindrical face. When a sector gate is stationary it is in equilibrium between its own weight and the pressure of any water flowing over it, acting downward, and the pressure of the water filling it and the pit below it, acting upward. This water is drawn from the river above the dam. In order to hold the gate in any one position it is necessary to maintain the water inside the gate at a constant pressure. This is done by connecting it with a vertical weir tube of adjustable height. The supply of water to the interior of the gate is regulated by sluice gates so that it will always overflow through the weir tube. Thus the pressure in the gate is determined by the weir-tube setting, and when the gate is to be raised or lowered it is necessary only to change the setting of the weir tube. The Taintor gates are counterbalanced and are raised only in times of high water.

Other Hydraulic Features.

The intake house, located in the center of the dam, is a concrete structure with curtain walls extending 4 feet below low-water level. This diverts floating debris from the trash racks and greatly reduces the labor of keeping them clean. By lowering the sector gates from time to time, any accumulation of debris can be washed clear. Behind the curtain walls are 16 openings, 10 feet wide by 12 feet high, controlled by steel gates operated from a traveling electric hoist.

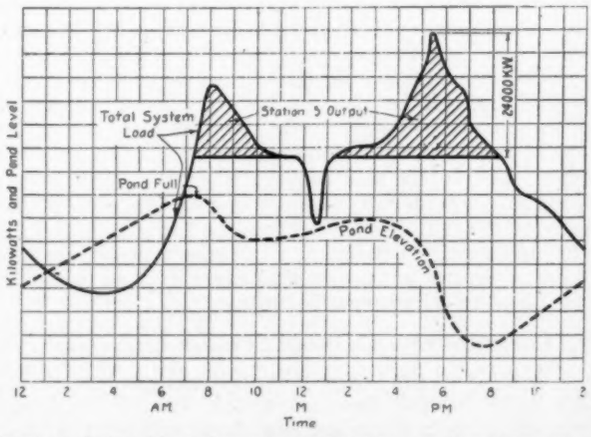
From the intake house a cylindrical tunnel 20 feet in diameter drops vertically and turns smoothly into the horizontal section. The level of the upper end of this is 95 feet below the bottom of the dam. It is of conventional horseshoe section, having an area equivalent to that of a circle 20 feet in diameter. In its length, 1400 feet, there is a drop of about 8 feet. At the lower end it widens to the penstock connection. Directly over this point is the vertical riser to the surge tank.

The surge tank is of steel, 60 feet in diameter by 40 feet high, located on a shelf of the high bluff above the power station. It is of the differential type in which a wave of high pressure forces water up and over the top of a central tube into the tank. When the pressure falls, the water flows back into the tube, through openings at the level of the tank bottom, more slowly than it entered.

Three steel penstocks are provided, one for the future unit being blanked off. They are 13 feet in diameter and terminate in Johnson valves which are closed to shut down the turbines. If desired, these valves may be calibrated for use as Venturi meters. They connect to the scroll cases of their respective turbines.

Vertical Francis turbines made by the I. P. Morris Company are used. They are rated 16,000 horsepower at 180 revolutions per minute, and 130-foot head, and have runners of 96-inch diameter. The governors are of the double floating-lever type and are oil-operated. They are provided with remote control from the switchboard gallery, and may be controlled by hand also.

The station structure itself is of reinforced concrete in simple lines with large window areas. It covers a space 75 feet by 20 feet, which allows liberal space for the two present units only. Before the third unit is installed, the old building adjoining it must be removed and the station extended. The generator floor is 14 feet above high-water level. From this floor to the bottom of roof trusses is 59 feet. A central line



Typical Daily Load Curve and Relation to Pond-Elevation Curve.

of columns supports the switch galleries which occupy one-half the station; the space over the machines is left clear for the crane.

Electrical Features of Plant.

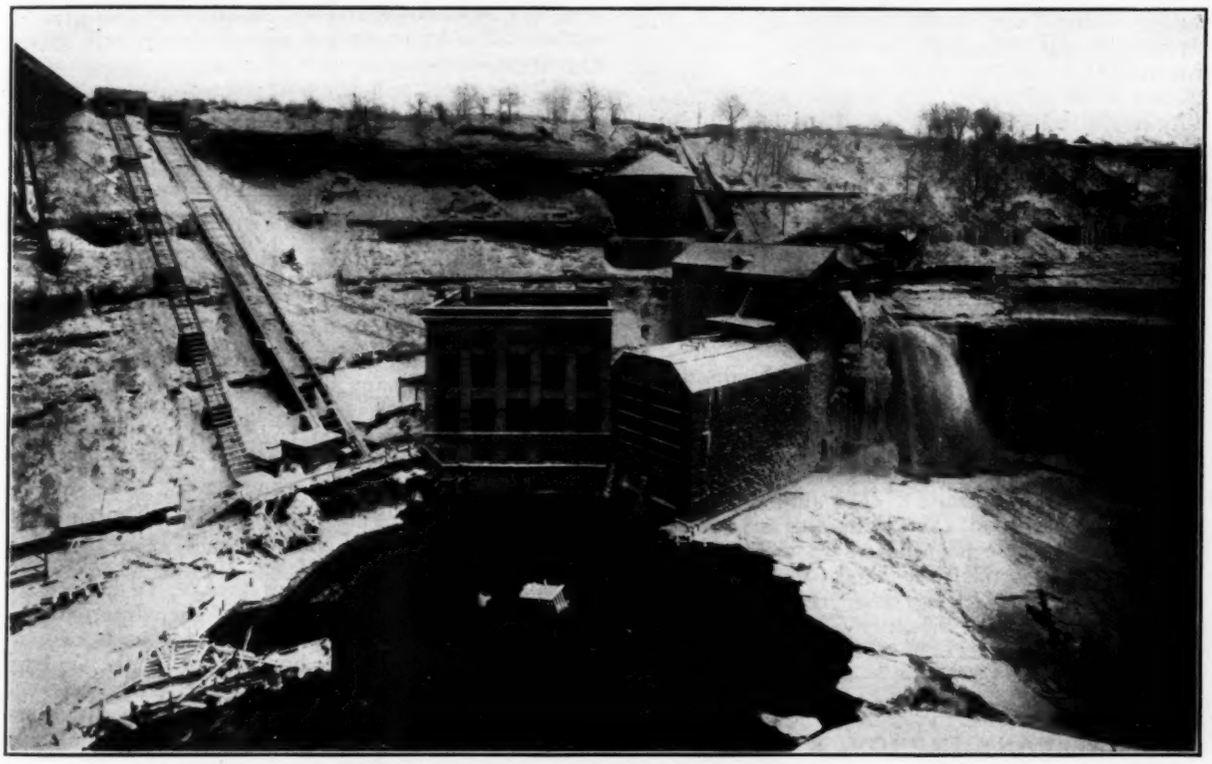
The two generators now installed were furnished by the Westinghouse Electric & Manufacturing Company. Each is rated at 12,500 kilovolt-amperes at 0.90 power-factor, three phase, 60 cycles, 11,000 volts, star-connected. Protection to the generators is given by the system of current transformers and relays proposed by Ricketts. In each phase a current transformer is connected at the inner end and another one in the cable just inside the first disconnecting switch. The secondaries of these transformers are connected across a Westinghouse overload relay. Normal conditions cause a current to circulate through the two secondaries, none flowing through the relay. Should a fault develop in the winding or cable, the leakage current would cause an unbalance in the transformer secondaries, which would force current through the relay. This would trip out the main oil circuit-breakers and open the field circuit of the machine in trouble.

The upper guide-bearing bracket of each generator carries a 100-ton Kingsbury thrust bearing, which supports the rotating parts and water reaction. Above this is mounted a 100-kilowatt, 250-volt exciter. Excitation can be secured also from a motor-generator set.

From the generators, 11,000-volt cables pass to the high-tension bus structure on the topmost gallery. The framework of this is a combination of brick piers and precast concrete slabs. The busbars are arranged in a tier of compartments running down the center, with oil-switch compartments on one side and disconnecting switches on the other. Since this station also supplies a distribution network in its vicinity, two 5000-kilovolt-ampere, three-phase transformers are installed in compartments on the main floor. These supply a 4150-volt bus on the first gallery level. Oil switches for the distribution circuits and for a number of arc transformers are located directly below this bus.

The main operating switchboard is located at the front of the first gallery. It was furnished by the Westinghouse Electric & Manufacturing Company, and includes panels for the generators, spare exciter, tie lines, etc. Black-dial meters are used throughout. Potentiometers for measuring the generator temperatures are located on the face of each generator panel and connected to thermocouples imbedded in the machine windings.

Auxiliary power is furnished by 440-volt, three-phase motors. These include the motor-driven spare-exciter unit; a 4.5-kilowatt motor-generator set for the control-circuit storage battery; two 3-horsepower motors driving oil pumps for the thrust bearings; two 15-horsepower motors driving governor oil pumps, and two compressors which furnish air for the governor accumulator tanks, for cleaning and for operating brakes on the generator fields for stopping. The crane motors are operated at 230 volts from the spare exciter. A double-throw switch connects this generator either as a shunt machine direct to the field-control panels for the alternators, or as a compound-wound machine through a circuit-breaker to the crane trolley.



Exterior View of Power Station Site, Showing Inclined Railways, New Station, Surge Tank and Old Station.

Official approval for the project was given in March, 1916, and ground was broken on May 15. The work included the removal of an old building on the power-house site, removal of an existing dam and construction of a new inclined railway down the nearly vertical bluff near the power house, to lower a 40-ton load. The entire job cost approximately $1,750,000. It was designed and supervised by the Engineering Department of the Rochester Railway & Light Company, under the general supervision of F. J. Howes, chief.

OHIO ASSOCIATION TO HOLD ANNUAL CONVENTION.

Customary Gathering to Be Held at Cedar Point in July to Discuss Important Timely Topics.

At the March meeting of the New Business Committee of the Ohio Electric Light Association, held at Columbus, Ohio, on March 20, announcement was made that the customary annual convention of the association would be held at Cedar Point next July. President McMeen, in his address of welcome, spoke strongly in favor of holding business conventions during the war as it was more important to meet for discussion of weighty and timely topics than even in normal times. He referred to the present abnormal conditions and the hardship caused by onerous franchise obligations in some localities because of these conditions.

Mr. Marsh gave a fine address on "Where Is the Money Coming From?" He expressed the conviction that the present difficulties in financing utility betterments and extensions would be relieved. Doubtless immense sums of money can be procured for public utility needs from the customers of the utilities themselves, especially from the men who until the Liberty Loans were not considered to be possible purchasers of securities.

After the luncheon Secretary D. L. Gaskill gave a fine address on the effect of war conditions on the utilities and announced that, contrary to last year's procedure, the annual convention would again be a general meeting at Cedar Point.

Mr. Eastman made an important address on "The Legal Aspects of a Contract." During the discussion it was stated that state utility commissions are in general not in favor of schedules of rates containing coal clauses.

An interesting paper was presented by Mr. Highley on domestic refrigeration. The author stated that electricity would soon come into extensive use for this purpose, because he believed there was likely to be a scarcity of artificial ice due to the heavy war needs for ammonia among other reasons. A more complete report of the meeting will be given in our next issue.

NORTHERN ILLINOIS LIGHT & TRACTION COMPANY IMPROVEMENTS.

Its Marseilles Hydroelectric Plant to Be Improved—Notes on Its Increased Power Load.

The Northern Illinois Light & Traction Company, having three central stations, delivers electric service to 40 towns, and supplies power in 25 of them. The generating capacities of its three stations are: La Salle, 7000 kilowatts; Marseilles, 4750; Ottawa, 1000 kilowatts. The plant at Marseilles is a hydroelectric plant, in which important improvements are to be made. Plans provide for replacing six waterwheels and generators, of an old type, with new turbogenerators. The proposed new equipment will result in an increase of 500 kilowatts at the Marseilles station. The other two stations are steam-electric plants. The three plants are connected by 33,000-volt lines, making an interconnected system that extends from Morris on the east to Spring Valley on the west.

Besides supplying light and power service direct to consumers, this company furnishes energy to the Spring Valley Utilities Company, whose business is distributing light and power in a country of considerable area, with Spring Valley as a center, and including a number of coal mines.

In the large territory served by the Northern Illinois company, the uses for central-station power have been increased considerably within the last month. Part of this increase comes from industrial plants which have electric generating equipment of their own; and they have been dropping off service from their own plants and taking on central station power. These changes may or may not be permanent. After the experiences of the past winter, with their troubles incident to the general coal shortage, the above-mentioned changes, temporary or otherwise, are suggestive of the idea that some of the factories and industrial plants might willingly rid themselves of the annoyance and expense of producing their own electric power if continuity of central-station service can be assured. The power problem for next winter may well be considered long in advance, and it is readily seen that greater centralization in producing electric power will result in reducing the consumption of coal.

There surely will come an increased demand for power at factories, and this will come as the result of supplying a sufficient number of cars in which to deliver fuel and raw material and to market products.

LARGE NEW POWER BUSINESS TO BE ADDED BY NORTHERN STATES POWER COMPANY DURING 1918.

A total of 21,000 horsepower in new power business will be added to the lines of the Minneapolis General Electric Company during the present year, contracts having already been accepted covering this business which includes 2500 horsepower additional for the Minneapolis Steel & Machinery Company; 1500 horsepower additional for pumping the city's water; 200 horsepower additional for the Pillsbury Flour Mills; 400 horsepower for the Twin City Trading Company; 200 horsepower for the Union Terminal Elevator; 200 horsepower for the W. P. Devereaux Company; 125 horsepower for the International Cereal Company; 100 horsepower for each of two stone crushing plants; 200 horsepower for the William Bros. Boiler Manufacturing Company; 520 horsepower for flour mills and the lighting and power requirements for the Y. M. C. A. and Builders' Exchange buildings now under construction.

In the St. Paul division 1175 horsepower of power business is in immediate prospect including 400 horsepower for dredging and filling operations at South St. Paul in connection with the new stock yards and the Armour packing plant and 325 horsepower additional for the Waldorf Box Board Company.

At Stillwater from 6000 to 7000 horsepower will be added to the plant of the Twin City Forge & Foundry Company alone.

In the Faribault division 2150 horsepower of power business to operate flour mills will be added during the spring and summer.

In the Mankato division 400 horsepower for operating flour mills will be added during 1918. Transmission lines constructed during 1917 pass through a number of communities which will be added to the company's system during 1918. Approximately 4000 horsepower of power business is on these lines which will be served by the Northern States Power Company subsequently.

Shall Transformers Be Banked in a Distributing System?

Effect of Banking Upon Investment, Economy and Service—Precautions to Be Observed—Proportioning of Fuse and Transformer Capacities—Safety Features for Service and Linemen

By M. E. GRAH

Regulation Engineer, Toledo Railways & Light Company.

THE reason for banking transformers in multiple on single phase lighting loads is to keep down energy losses, eliminate excessive voltage drop due to length of secondary, and reduce copper size in the main belt. This type of distribution should be limited to districts where the load has become practically stable or, in other words, in a district which has reached the saturation point so far as further building is concerned. Of course, by this it is not meant that the load may not increase, but where the increase will not develop as in districts which have not reached this stage.

To take an example. The district to be considered will at present be served by different sizes, type and make transformers, different sizes of secondary copper, and the transformers so located that it will not be possible to arrange for banking. As is the experience in most companies, the first installation has been added to from time to time as the load has required without any idea of banking, until eventually there is perhaps a great deal of equipment which, while at the time of installation was necessary, may be improved upon for better efficiency by redesign.

To determine this it is necessary to make a thorough survey of the district to determine the connected load and the present demand. This information will enable one to better design the bank, eliminate a number of small capacity transformers, replacing them with fewer transformers of larger capacity. This change will reduce existing core losses and unit costs.

For example, compare standard 60 cycle, 2200 volt to 220-110 volt transformers. The losses of a 1 kilovolt-ampere unit are 20 watts iron loss, 24 watts copper loss, a total of 44 watts at full load. The efficiency will be 95.8 per cent at full load with 2.4 per cent regulation at 100 per cent power factor. A 5 kilovolt-ampere unit has 43 watts iron loss, 82 watts copper, a total of 125 watts, with an efficiency of 97.5 per cent at full load, and 1.7 per cent regulation at 100 per cent power factor. A 25 kilovolt-ampere unit has a loss of 138 watts iron, 305 watts copper, a total of 443 watts. The efficiency rating is 98.2 at full load and 1.3 per cent regulation at 100 per cent power factor. In summing this down, it is found that the iron loss, which is constant regardless of load, compares as follows. A 1 kilovolt-ampere unit has 20 watts loss, a 5 kilovolt-ampere unit has 43 watts loss or 8.6 watts per kilovolt-ampere, and a 25 kilovolt-ampere unit has 138 watts loss, or 5.5 watts per kilovolt-ampere. When figured in dollars and cents, this amounts to quite an item and should deserve consideration. Also note that the I^2R loss, or copper loss, also decreases with larger sizes, the efficiencies are better and the regulation improves.

From the foregoing data it can be seen it is not good practice to bank unequal capacities together, by so doing the larger units will take more than their share of load and different types and makes are not balanced well enough to allow this, and by keeping away from this we will have better regulation.

The curve shown in Fig. 1 gives the comparative costs per kilovolt-ampere of standard 2200-volt distributing transformers, from which it will be seen the cost per kilovolt-ampere decreases very rapidly with increasing capacity. From these figures we can see where it is economy in using larger capacities wherever possible, eliminating more numerous and smaller capacities.

There is another saving which follows by using larger capacities and eliminating numbers of smaller units and that is, it is good practice to install lightning arresters on the primary to protect the transformers. With a smaller number of transformers we save the cost of lightning arresters by eliminating the smaller and using larger capacities.

The next item to be considered is the saving in secondary copper due to banking. Under this head it is necessary to first determine the limit of capacity which we shall allow to the entire bank. It is the writer's opinion that 100 kilovolt-amperes should be the limit. If the primary feed is three phase or two phase this does not offer too much capacity to balance against. Also the larger capacities will require a good deal more inspection and maintenance. It must be remembered that the banking of transformers should be watched very closely to insure success and proper regulation.

The next item is how far apart the transformers may wisely be spaced. To obtain the desired results, the spacing should be so calculated that the energy from one unit will overlap the supply from the two adjacent units in the circuit to such a degree that between any two units the regulation will not be greater than 3 per cent, which is ample allowance. The allowable spacing for this degree of regulation is between 1200 to 1500 feet. This spacing allows one unit to help the other and keeps down excessive secondary line copper. Where the transformers are spaced a greater distance apart, there is no advantage in banking units.

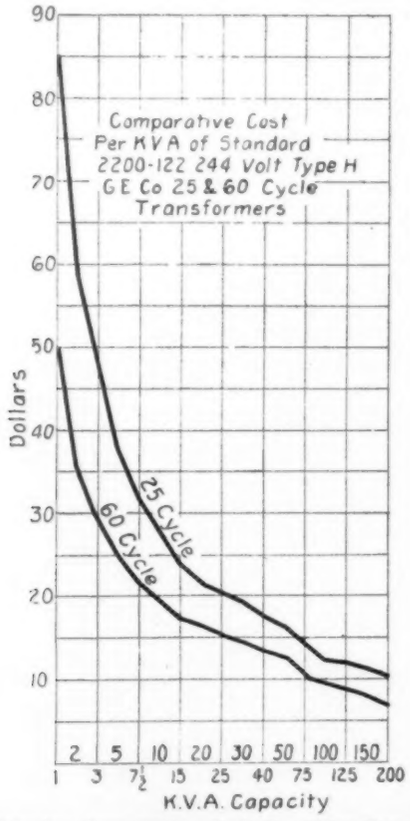
Economy of Banking.

In calculating the load for a residence district it will be found that the diversity factor of this class of business is very low, generally averaging as low as 10 to 30 per cent. H. B. Gear, distribution engineer, Commonwealth Edison Company, Chicago, in 1910, found the following diversity factors: 29.8 per cent between consumers on residence lighting and 77 per cent between transformers. With the advance

of small auto-charging sets and appliances it has been necessary to increase transformer capacities and the above figures are thought to be a trifle high. The diversity factor is very important not only in single unit installations of distribution, but when considering banking. Take, for example, a connected load of 375 kilovolt-amperes with a diversity factor of 20 per cent spread over a belt of 6000 feet. Suppose this 60-cycle, single-phase, 220 and 110-volt load is evenly distributed by using single transformers with lines 1000 feet each way. It will require three 25-kilovolt-ampere transformers and 12,000 feet of 1-0 and 6000 feet of No. 2 line. The cost of the transformers will be $1140 and the cost of the line $1414.80. Not including labor or other necessary material, this gives a total of $2554.80. By redesigning this line and banking five 15-kilovolt-ampere transformers 1200 feet apart, 12,000 feet of No. 4 and 6000 feet of No. 6 will be required. The cost of transformers will, in this case, be $1310, that of the line $556.80, a total of $1876.80, equivalent to a saving of over 26 per cent over the single transformer installation. This is only an example. Of course, the core losses will be greater with the 15 kilovolt-ampere units, but in actual experience the larger units would not be found, but a number of smaller ones instead, which would increase the iron losses considerably.

Proportioning Primary Fuses.

The next item is what size fuse to use on the high tension side of the transformer with references to the



Curve Showing Comparative Cost Per Kilovolt-ampere of Distributing Transforme.

rate capacity of each unit. Here it will be necessary to take into consideration the continuity of service, as this is very important. It is also experienced that the present-day transformers are not designed as liberally as were the older types, or, in other words, they cannot be overloaded as they could in the past. This is not a fault by any means, because by the closer design better efficiencies, regulation and weight have been attained. With some companies the practice is to rather lose a transformer than have the primary fuse blow, and by this practice overloaded transformers are very apt to occur unless their loads are very carefully watched. An overloaded transformer is not an asset. With the advance of electricity and increasing use of small motors, motor generator sets, rectifiers, and any other inductive load supplied from the lines, whose starting current values exceed the running current, it is the writer's opinion that the fuse size on the high tension side should be not smaller than 50 per cent above the rated capacity of the transformers, keeping in mind low power factors of the load to be served. This should allow enough capacity so that the primary fuse will not blow, unless the trouble is so serious that the circuit should open to avoid loss of transformer.

The following list of fuse sizes has been prepared which at 2300-volt will accommodate the various sized transformers from 10 to 30 kilovolt-amperes and hold as near 150 per cent rated capacity, or 50 per cent overload, as is possible with fuse sizes available. According to the National Code, all link fuses must be stamped with about 80 per cent of the maximum current which they can carry indefinitely, thus allowing about 25 per cent overload before the fuse melts. This is equivalent to about 200 per cent load using the sizes calculated below, before the fuse will blow.

Transformer rated capacities in Kilovolt-amperes.	Size fuze in amperes.	Per cent rated capacity.	20 per cent equals.
10	7	161	201.25
15	10	153	191.8
20	14	161	208
25	16	147	184
30	20	153	191.6

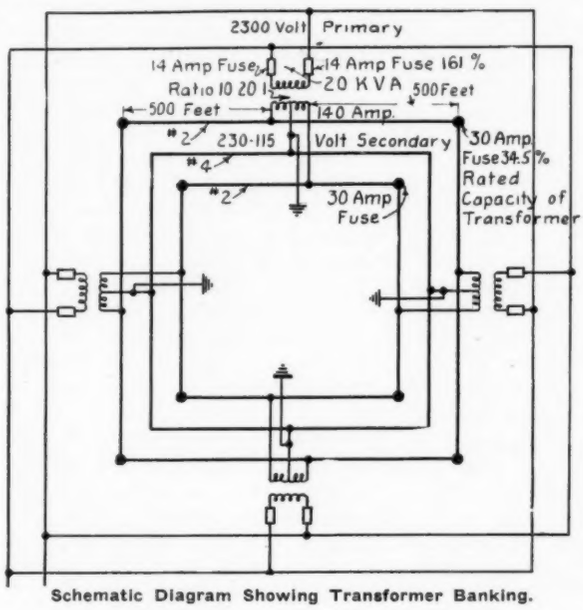
Use of Secondary Fuses.

The next item to consider is shall the low tension side be fused and whether at the transformer or at a neutral point on the secondaries between transformers. If the secondary is not fused, in case of failure of any of the transformers, the primary fuses of all the units in the bank are very apt to blow and when this happens it is impossible to get the bank alive again until the secondaries are separated, as it is practically unfeasible to get all the units back simultaneously. This has been one of the great objections to banking transformers. There is another factor, however. If the primary fuse blows and the secondary is alive from the other transformers, the transformer in trouble is alive and should not be inspected until the secondary has been disconnected. If the secondary is fused at the transformer, a saving of time getting to the transformer in trouble for inspection accrues, but it is the writer's opinion that this does not obtain the desired results expected from banking and also requires fuse sizes the cost of which would be too great for the benefits derived. By fusing the primary as near 150 per cent as possible and locating the neutral point as near as possible between the transformers on the secondaries, it follows that fusing at this point as near 30 per cent of the rated capacity of one of the transformers protects the transformers each side of fusing point if of the same capacity. For example, consider a bank of 80 kilovolt-ampere capacity made up of four 20-kilovolt-ampere 2300-220-110-volt transformers. From the foregoing list of fuse sizes a 14-

ampere fuse would be recommended for the primary. This gives a total maximum capacity of 128.8 kilovolt-amperes or 32.2 kilovolt-amperes per transformer, or 140 amperes at 230 volts. Assume the transformers are 1000 feet apart. The full load rating of the transformers will allow 87 amperes per transformer at 230 volts. With the load equally divided at the transformer this allows 43½ amperes both ways from each transformer. By locating the fuse as near as possible at the neutral points, which it may be supposed is exactly half way, or 500 feet from the two transformers in question, and fusing the two outside wires with as near 30 per cent of the rated capacity of one of the transformers, a 30-ampere fuse may be used, which will allow an interchange of 30 amperes, or 6.0 kilovolt-amperes between transformers. This may seem a little small, but in case of failure of any one of the transformers this neutral fuse blows before allowing either of the adjoining units to be loaded over 134 per cent of rated capacity, and with the 161 per cent fuse in the primary allows enough capacity to keep the balance of the bank in operation. To prevent accidental grounds it is recommended that the neutral of the secondary belt be grounded as near each transformer in the bank as possible. If primary lightning arresters are not located on transformer poles, the neutral should be grounded at this point; if they are, neutral should be earthed at first pole adjacent.

From what has been said it can readily be seen how necessary it is that a complete survey be made and each particular installation be designed to obtain results from banking single phase transformers in multiple.

A good opportunity is open for some manufacturer to design a suitable fuse and block for the neutral point of bank transformers as this piece of apparatus is exposed to the weather. The fuse should also have some indicating device to facilitate quick inspection and replacement of the fuse. The present types of transformers do not allow the overload that the older types do, and for better service generally a primary fuse and block that allows closer limits of the rated capacities is badly needed.



Schematic Diagram Showing Transformer Banking.

One more point. To insure good operation with banked transformers it is absolutely essential that the proper fuses be used and to facilitate this a diagram of the bank should be issued to the trouble department showing sizes and location of transformer and fuses with the injunction that directions be adhered to explicitly.

The above, slightly condensed, was a paper read at the February meeting, at Cincinnati, of the Transmission and Distribution Committee, Ohio Electric Light Association.

TABLE I—COMPARATIVE COST DATA.

Size.	Type.	Weight per foot bare.	Weight per foot T.B.W.P.	Cost per foot at base, 28c. lb.
0000	Solid	.641	.775	$0.1795
0000	Stranded	.645	.8	.1808
00	Solid	.403	.49	.113
00	Stranded	.406	.522	.118
0	Solid	.32	.4	.0896
0	Stranded	.322	.424	.0902
1	Solid	.253	.306	.0708
2	Solid	.202	.268	.0566
4	Solid	.126	.164	.0353
6	Solid	.079	.112	.0222

TABLE II—CALCULATING 1,000 FT. 3-WIRE SECONDARY 2-WAYS FROM TRANSFORMER, TOTAL 2,000 FT. LINE, 230-115 VOLT.

Transformer, K.V.A. capacity.	Wire size required, 3% drop.	Total amount wire in ft.	Cost per ft. at base, 28c lb. bare.		Copper cost.	Transformer cost, type H.G. E.Co., 2,200-122-244 volt. 60 cycle.	25 cycle.
		4,000-4	$0.0353	$141.20			
1.....	4-6-4	2,000-6	.0222	44.40	$185.60	$ 60.00	$ 85.00
		4,000-4	.0353	141.20			
2.....	4-6-4	2,000-6	.0222	44.40	185.60	71.00	117.00
		4,000-4	.0353	141.20			
3.....	4-6-4	2,000-6	.0222	44.40	185.60	88.00	142.00
		4,000-4	.0353	141.20			
5.....	4-6-4	2,000-6	.0222	44.40	185.60	124.00	187.00
		4,000-4	.0353	141.20			
7½....	4-6-4	2,000-6	.0222	44.40	185.60	162.00	238.00
		4,000-4	.0353	141.20			
10.....	4-6-4	2,000-6	.0222	44.40	185.60	197.00	279.00
		4,000-2	.0566	226.40			
15.....	2-4-2	2,000-4	.0353	70.60	297.00	262.00	358.00
		4,000-2	.0566	226.40			
20.....	2-4-2	2,000-4	.0353	70.60	297.00	323.00	435.00
		4,000-0	.0896	358.40			
25.....	0-2-0	2,000-2	.0566	113.20	471.60	380.00	509.00

TABLE III—CALCULATING 600 FT., 3-WIRE SECONDARY, 2-WAYS FROM TRANSFORMER, TOTAL 1,200 FT. LINE, 230-115 VOLT.

Transformer, K.V.A. capacity.	Wire size required, 3% drop.	Total amount wire in ft.	Cost per ft. at base, 28c lb. bare.		Copper cost.	Transformer cost, type H.G. E.Co., 2,200-122-244 volt. 60 cycle.	25 cycle.
		2,400-4	$0.0353	$84.72			
5.....	4-6-4	1,200-6	.0222	26.64	$111.36	$124.00	$187.00
		2,400-4	.0353	84.72			
7½....	4-6-4	1,200-6	.0222	26.64	111.36	162.00	238.00
		2,400-4	.0353	84.72			
10.....	4-6-4	1,200-6	.0222	26.64	111.36	197.00	279.00
		2,400-4	.0353	84.72			
15.....	4-6-4	1,200-6	.0222	26.64	111.36	262.00	358.00
		2,400-4	.0353	84.72			
20.....	4-6-4	1,200-6	.0222	26.64	111.36	323.00	435.00
		2,400-4	.0353	84.72			
25.....	4-6-4	1,200-6	.0222	26.64	111.36	380.00	509.00

NEW HYDROELECTRIC PLANT IN SOUTHERN CALIFORNIA COMPLETED.

Fontana Power Company has completed a hydroelectric power plant near San Bernardino, Cal., of the capacity of 2500 kilowatts, and which is being operated under lease to Southern California Edison Company of Los Angeles. The new plant was designed by and built under the engineering supervision of McMeen & Miller, Monadnock Block, Chicago. The plans required the diversion of water from Lytle Creek and carrying it through 4½ miles of 42 and 36-inch steel pipe to the power plant, which is equipped with a Pelton impulse wheel and Westinghouse generator and other electrical equipment. The water, after passing through the plant, is turned into canals and ditches for irrigation purposes. This is an example of how it might be possible in other places to make hydroelectric and irrigation projects co-ordinate with each other in power and food production.

Water Pumping by Electric Power

Second Part of Article Discussing Characteristics of Motor-Driven Pumps and Giving Suggestions for Selection of Pumps for Municipal Water Pumping

By R. L. YATES

Assistant Manager, Platt Iron Works, Dayton, O.

ECONOMIES in plant operation and efficiencies of the pumping equipments used do not necessarily parallel each other. The efficiencies of reciprocating pumps are, as a general rule, in excess of the efficiencies to be obtained by the use of centrifugal pumps. On the other hand, it is quite possible because of the higher initial cost of the reciprocating pump together with its accessories, and considering also the larger size of building that may be necessary for same, also the additional operating expense that will likely attend same, that the centrifugal might prove to be the more economical from a plant standpoint. Again, it may be desirable to obtain in the pumping unit a range in capacity and pressures, which condition can be solved by a centrifugal pump and not by the triplex. The choice in equipment therefore again becomes a study for the engineer.

Fig. 3 shows approximately a comparison in efficiencies to be obtained from triplex pumps and centrifugal pumps operating under best conditions and for capacities up to 1500 gallons per minute. The efficiencies given for the triplex pumps are based upon the most economical point in operation, which is standard capacity and a pressure head of approximately 300 feet for standard design. The efficiencies named for the centrifugals are for normal points in operation and as shown by the 100 per cent values in Fig. 1.

The efficiencies of reciprocating pumps are reduced somewhat when operating under pressures less than 300 feet. Fig. 4 shows the ratios that generally obtain when operating at these lower pressure heads. For instance, Fig. 3 shows that a pump of 1000 gallons capacity would have an efficiency of 80 per cent. This efficiency would obtain were the pump to operate at a head of 300 feet. If we now assume that this pump is to operate under a head of 150 feet the efficiency then would be 90 per cent of that for 300 feet, or 72 per cent and this latter figure would be used in determining the power for operating the pump. These ratios again affect the comparison between triplex and centrifugals shown in Fig. 3, and show that when operating under low-head conditions, the centrifugal may be the more economical.

Fig. 3 shows the approximate efficiencies that will be obtained by the use of centrifugal pumps irrespective of the head for which the pump may be designed. In other words, a 600-gallon centrifugal properly designed will have an efficiency near 65 per cent whether the operating head may be 50 or 150 feet. Fig. 1 shows the variation in efficiencies that will obtain generally in centrifugal pumps, when varying the capacity from its normal operating point. Efficiencies at part capacity on a centrifugal are higher than can be obtained with a reciprocating pump, as the latter type must pump full capacity, unloading part of same through a relief valve and this becoming therefore a direct loss.

The proper determination of pressure and suction conditions and a study as to the range in operating conditions that may obtain in obtaining the high efficiencies at all times, seems to be from the above of importance.

The power required for operating either a triplex or centrifugal for given conditions becomes easily determinable from the above data and the formula for this calculation is,

$$P = \frac{H \times Q}{3957 \times E_p \times E_m}$$

where P = horsepower of the pump motor; H = head, in feet; Q = quantity of water pumped, in gallons per minute; E_p = efficiency of pump; E_m = efficiency of motor.

This horsepower obtains for operation under normal conditions, and is subject to increase of decrease when departing from these normal conditions, the amount of same depending upon the type of pump, or the accessories that may be used with the pump.

A triplex pump should always be equipped with a relief valve of the spring or other types, and set to a pressure slightly in excess of the maximum pressure

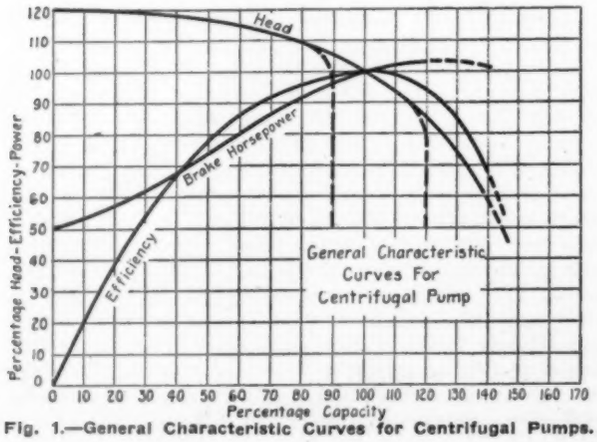

Head
Brake Horsepower
Efficiency
General Characteristic Curves For Centrifugal Pump
Percentage Head-Efficiency-Power
Percentage Capacity
0 10 20 30 40 50 60 70 80 90 100 110 120 130 140 150 160 170
0 10 20 30 40 50 60 70 80 90 100 110 120

Fig. 1.—General Characteristic Curves for Centrifugal Pumps.

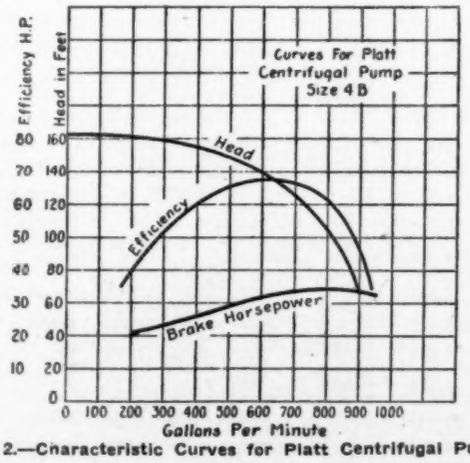

Curves For Platt Centrifugal Pump — Size 4 B
Head
Efficiency
Brake Horsepower
Efficiency H.P.
Head in Feet
Gallons Per Minute
0 100 200 300 400 500 600 700 800 900 1000
0 10 20 30 40 50 60 70 80
0 20 40 60 80 100 120 140 160

Fig. 2.—Characteristic Curves for Platt Centrifugal Pump.

against which the pump is normally to operate. With a decrease in the demand for capacity the pressure in the pump then rises to the limit provided in the relief valve, and by-passes the amount of water required. This means that the driving power of the motor should be based upon the relief setting rather than upon the normal operation of the pump. A special type of relief valve, known as a by-pass valve and unloader, can be obtained, and which can be designed to operate at a predetermined limit in pressure, closing the discharge line and by-passing the water from the discharge of the pump to its suction, thus relieving the pump of any pressure other than what might be necessary to overcome the friction within the pump itself. The addition of this by-pass valve or unloader, although it may entail additional expense, will provide a plant economy much in excess of what would be obtained with the ordinary type of relief valve. This is of value in connection with direct-pressure systems, in fact, is considered as one of the essentials by many engineers. Naturally the power required to drive this triplex pump under these low-pressure conditions is considerably less than the normal requirements.

The power required by centrifugal pumps, when operating at conditions other than normal, is shown by Figs. 1 and 2 approximately. It is noted that the power shown for zero capacity is approximately 50 per cent of normal. (This figure varies for different designs of impellers from 30 per cent to 70 per cent; 50 per cent, however, covers the ordinary design for municipal work.) It is noted also that the maximum power is obtained when the pump is operating at heads lower than normal, and with capacities greater than normal. An impeller can be designed so as to be of the so-called non-overloading type; the results shown in Fig. 2 are made from such an impeller. A non-overloading impeller may possibly be defined as one which will not call for an overload greater than 10 per cent of the normal output of the motor, and when operating at any conditions from zero capacity up to its maximum capacity, and for any head or pressure conditions they may be obtained from the constant speed of the motor. It is evident that an unloading device such as named above for reciprocating pumps cannot be used with centrifugal pumps, as the power required tends to increase with the increase in capacity and decrease in head.

Pumping equipments are chosen primarily for operating under domestic-pressure conditions. However, they must be able to operate under fire-pressure conditions. The charts and above show that to obtain fire pressures with a triplex or reciprocating type of pump, the higher pressure can be obtained by simply setting the limit of the relief valve to that fire pressure, and to arrange for cutting off, automatically or by hand, such standpipes or reservoirs as may be floating on the line when fire conditions prevail. In a centrifugal pump, Fig. 1 and 2 show that the increase in pressure cannot be had in the single pumping unit, unless the speed could be varied so as to increase this pressure up to fire pressure. The proper increase in speed is usually not possible in alternating-current work, and therefore it becomes necessary when using centrifugal pumps to use two pumps operating in series for fire conditions, and the additional advantage is then obtained that the pumps can operate at the larger quantities that may be required for fire purposes.

We have not dealt in this paper with the cost of pumping, except wherein we may have shown that this cost can be affected by improper choice of equipment or application of same. A comparison, however, of the initial cost of pumping machines may be of interest. Fig. 5 will give a very rough idea as to the ratio of cost between triplex and centrifugal pumping units for capacities up to 1500 gallons per minute. Any curve of this kind can only be a rough estimate as to cost, as conditions of labor and material are so widely variable and also the choice of equipments may affect this ratio. The curve shows that for a 600-

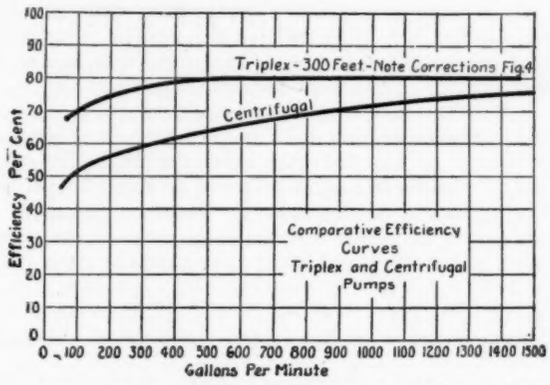

Triplex - 300 Feet - Note Corrections Fig 4
Centrifugal
Comparative Efficiency Curves Triplex and Centrifugal Pumps
Efficiency Per Cent
Gallons Per Minute
0 100 200 300 400 500 600 700 800 900 1000 1100 1200 1300 1400 1500
0 10 20 30 40 50 60 70 80 90 100

Fig. 3.—Comparative Efficiency Curves of Triplex and Centrifugal Pumps.

gallon pump the triplex outfit would cost approximately five times that for a centrifugal pump. This curve only emphasizes to a greater extent the necessity of study in operating conditions, and is placed in this paper to obtain this emphasis rather than to be used as basis for any calculations to be made in the future. Any data as to cost of particular equipments can be obtained quickly from the manufacturer.

Observations on Selection of Pumping Equipment.

A few observations can be made from the above and, although these observations cannot be considered as conclusive as to choice of equipment for different distributing systems, I believe that proper conclusions for particular cases can be reached by a further study of the charts and data given above.

A triplex pump fitted with a pressure unloader would seem to be most applicable for direct-pressure systems without storage, as it could then handle the full capacities at low operating pressures during such times when the full capacity is not called for in the main. In other words, the power required during these periods would be a small part of the full power of the motor. It is to be noted that best operation is secured when the unloader is augmented by a compressed-air tank, or a standpipe to act as an accumulator or governor and to take the sudden calls for capacity or pressure, thus relieving the unloader from operating so frequently.

A triplex or centrifugal pump would be applicable for such systems that could employ the use of a large storage tank or reservoir. In such a system the pumps would operate for given periods at constant capacity, pumping directly into the tank, therefore, always at best economy. The tanks would be used to feed the mains. The pumps would be started and stopped automatically by pressure regulators. The tanks should be of such size as to permit the pumps being at rest for, say, a few hours' time even in peak-load conditions. In other words, the tanks would be feeding the city mains for that period.

A combination of the two above systems can be used advantageously in some localities where the topography of the land surrounding the village permits of a large storage tank at comparatively low initial cost.

Centrifugal pumping units should be used in duplicate in such cases where the fire pressure exceeds the domestic pressure, at this time operating in series as described above. It can be assumed that duplicate pumping units should be used in every municipal plant to cover emergencies, and therefore the duplicate centrifugal for fire purposes should not be considered wholly as an expense against fire protection, but as an insurance for continuous domestic operation also.

The main duty of a power engineer from the central-station standpoint is, I believe, the promotion of the sale of power for that central station. In other words, he is the salesman first and an engineer second. The confidence of the customer must be obtained before a sale of power or anything else can be made, and to obtain this confidence the salesman must know more about his subject than does the customer. Therefore, it is necessary for the power engineer to be well enough versed with the design, application and operation of pumping equipments to handle any preliminary situations which might arise in his discussions with the customer and until such time as he can discuss with the pump manufacturers the finer points regarding the application and operation of these pumps.

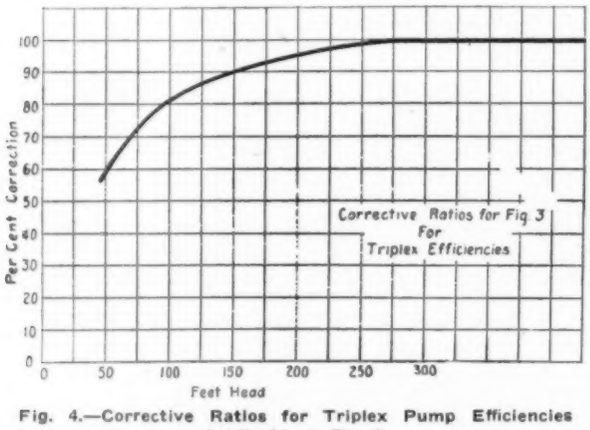


Fig. 4.—Corrective Ratios for Triplex Pump Efficiencies Applicable to Fig. 3.

A list of questions, answers to which will acquaint the pump manufacturer with the requirements of the situation, are given herewith in the hope that they may be of assistance in determining upon the choice and application of pumping equipments.

1. Number of pumps required.
2. Nature of service.
3. Is vertical or horizontal installation desired?
4. Capacity required in gallons per minute.
5. Total pumping head, including suction, discharge head and friction head.
6. Maximum suction lift, including all friction.
7. Length and size of suction and discharge pipes, giving number and kind of elbows.
8. If pumping head is variable, give maximum variation for both suction and discharge.
9. If pump is located below source of supply, will it be submerged or placed in a dry pit?
10. Will pump be required to operate continuously? If not, at what intervals?
11. Nature of liquid to be pumped—hot, clear, fresh, alkaline, cold, gritty, salt, acidulous—give temperature and specific gravity.
12. If pump is belt-driven, give speed and diameter of pulley.
13. Furnish certified motor dimension print.
14. Make sketch of proposed pump setting showing piping.

ENGLISH RAILROAD ELECTRIFICATION SUCCESSFUL.

Most satisfactory results of electrification carried out during wartime are reported by two of the chief railroad systems in England—the London & Northwestern and the London & Southwestern. The chairman of the former says that with a complete year's comparison of the traffic on the electrified portion of the suburban lines the figures are such as to "astonish the most sanguine." In 1917 they carried 10,000,000 more passengers than in 1915. The electric trains had proved so popular that it was now practically impossible to get a house in the districts served by them. Any further extension of the electrified area is impossible during the war; indeed, inability to increase the electric rolling stock is causing much overcrowding. In the case of the through running on the London electric tube lines to Watford, in connection with the London & Northwestern, operation since April last has produced results even more satisfactory than was anticipated. Whether England's railroads remain under national control or not after the war, large electrification measures may be regarded as a certainty. Not only have the above records done much to clear away former conservatism but the larger views now generally held respecting efficiency and coal conservation are greatly assisting the movement toward electric traction.

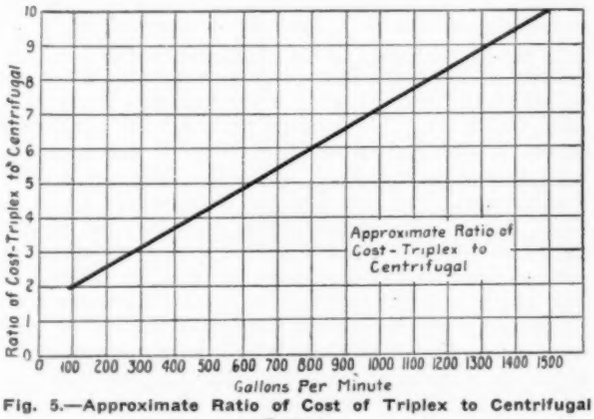


Fig. 5.—Approximate Ratio of Cost of Triplex to Centrifugal Pumps.

Mountain States Power Company Acquires Property.—The Mountain States Power Company has acquired all the property of the Northern Idaho & Montana Power Company in Oregon, Washington, Idaho and Montana. The property operating as Oregon Power Company with headquarters at Eugene and Marshfield, Ore., will continue to operate as the Oregon Power Company. The properties, with headquarters at Kalispell, Montana, and Sandpoint, Idaho, will operate under the name Mountain States Power Company. The company will be under the operating direction of Elmer Dover, vice-president of H. M. Byllesby & Company, with headquarters at Tacoma, Wash.

Electrical Courses at the School of Engineering of Milwaukee

Unique Combination Worked Out of Teaching Electrical Theory and Practice—Elementary and Engineering Courses — Co-operative Educational Plan—Earn While You Learn

THERE never was so great a need for technical education and vocational training as now. The army and navy need thousands of engineers and skilled artisans close to the fighting lines and other thousands in the industries supplying the munitions of war. Vast numbers of trained men have been taken from the various industries for active service. Efficiency requires that these men be replaced by men or boys with as complete a preliminary training as possible.

In the various branches of the electrical industry the desirability of such training is probably greater than in nearly all other industries even in normal times. But in these abnormal times this need is still greater. Not only have thousands of electrical engineers and electricians been called for active service, but electrical manufacturers, central stations, electric railways, telephone and telegraph companies have had to meet greatly increased demands for their products and service with seriously depleted forces.

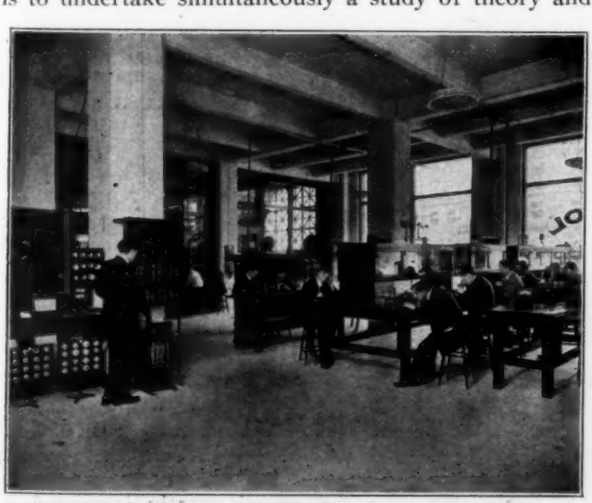
This situation in the electrical field has given considerable concern to the managers of central stations, telephone systems, electric railway lines and electrical manufacturing plants. While the employment of untrained persons has been possible to a limited extent, this is evidently inadvisable for positions where a knowledge of electrical matters is essential. For this reason a description of an intensive system of electrical training that has been worked out very successfully is doubtless timely.

General Educational Scheme of School of Engineering.

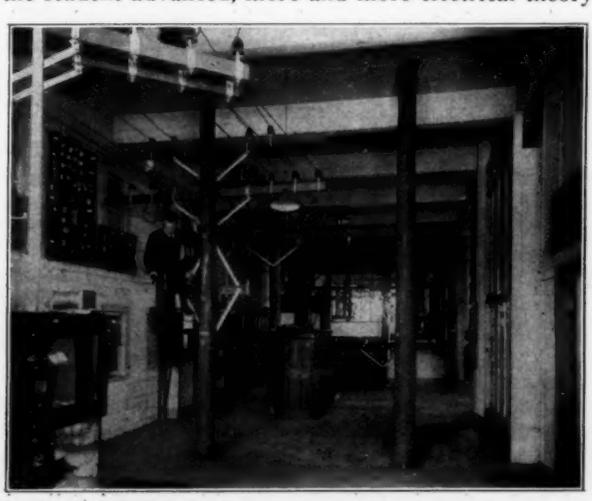
The city of Milwaukee, Wis., is fortunate in being the seat of an educational institution in which a unique method of teaching electrical science and art has been developed. The fundamental principle of this method is to undertake simultaneously a study of theory and practice so that the student instantly grasps the meaning of electrical laws by seeing them practically applied and also understands the reasons for the adoption of certain practices through a study of the theory that dictated them. It was felt that the method used by many technical colleges of overemphasizing theory throughout the curriculum, and especially in the first year or two of the course, leads to loss of interest and lack of appreciation of the importance of what is being taught and, moreover, very much of the information is forgotten before it is applied to engineering practice. Almost invariably the ordinary graduate of such courses, lacking a proper conception of actual practice, has to start practically at the bottom like an apprentice when he seeks a position in the practical commercial field.

Most students eager to get a technical education are willing to acquire it at considerable sacrifice. In fact, students that work their way through college usually have the backbone that makes for success in after life. However, where the student earns part of his expenses by doing menial tasks, such as washing dishes or waiting on table, little of permanent value is obtained from his employment. Much better results are secured by placing the student at work part of each day in an industrial or commercial establishment where he can see and take part in the practical application of what he is studying.

This newer scheme of engineering education has been followed by the School of Engineering of Milwaukee throughout its career, which began in 1905. From the first it was determined to give lectures, laboratory and practical work simultaneously so that in the electrical course the young student would immediately enter an elementary laboratory class in which the principles of simple circuits and the meaning of the most common electrical terms would be demonstrated. As the student advanced, more and more electrical theory



View in General Electrical Laboratory.



Pole Line for Instruction in Lineman's Work.

together with related mathematics, drafting, and general science were presented in lecture and recitation rooms at the same time that the laws being studied were verified and applied in the laboratories, and also in the industrial plants of the city. By this method it was found that the students not only comprehended the advanced theory much more readily than students following the older method, but that it had a vital and practical meaning to them which was much more likely to "stick."

The immediate value of such a course of instruction was further enhanced by following practically from the start the part-time study plan. Positions were secured for the students with leading Milwaukee electrical concerns, the arrangement being that students attended the School of Engineering half a day and worked in the electrical or other industrial plants the other half day. This co-operative plan has been found not to be a hardship on the student; on the contrary,

Motor-Testing Laboratory.

it has enabled him to pay part or nearly all his expenses from his earnings as he continued in the course —a great boon to students in modest circumstances, many of whom would otherwise be deprived of educational opportunities, and an incentive to earnest, hard work and self-reliance to students from more affluent families. Furthermore, this plan gave the student an insight into the methods and needs of large industrial and commercial concerns, where he could see what is actually required of a technical man and therefore could readily secure a good position on completing this course without beginning at the bottom of the ladder. In fact, positions are practically guaranteed by the employer, and the student is developed by the school "to the pattern of the industry."

Summed up in a few words, the course of instruction at the School of Engineering is of an intensive character aiming to secure the maximum possible results for the student without lost motion in studies and without overtaxing his capacity—on the "earn while you learn" plan of co-operation with the electrical industries. Important details of the methods used in carrying on the work are given below.

Growth and Development of the School.

Milwaukee, being one of the largest and most active centers of electrical industries, is the ideal location for carrying out such a co-operative educational plan.

The success obtained by the School of Engineering of Milwaukee in following out this general policy is well shown by its very rapid growth. Starting in a modest store and basement at 1027 Winnebago Street in 1905, the school has steadily grown until it now occupies two floors in the Stroh Building, 161-171 Michigan Street, opposite the Milwaukee Post Office, and all of the fifth and parts of the fourth and sixth floors in the Insurance Building at Broadway and Michigan Street. Both these buildings are well located near the center of the city. The former one is occupied entirely by electrical laboratories, while in the latter building are the general offices of the school, its library, numerous lecture, recitation and drafting rooms, the chemical, magnetic, photometric and commercial testing laboratories and the rooms of the newly organized radio department.

At first the school devoted itself chiefly to practical electricians' courses. When it was shown that its method was correct and was producing valuable results for its students, the courses of instruction were

A Class in Armature Winding.

gradually broadened until now the most advanced course offered is the three-year electrical engineering course. In the latter there is given in three years what usually takes four years in the ordinary technical college. There is also offered a three-year course in commercial engineering and one-year electrician and special six-month vocational courses, such as for linemen, metermen, cablemen, etc. Classes are conducted morning, afternoon and evening. Each class is limited to such a number that each student can receive the individual attention of his teacher.

The school has been fortunate in having on its faculty at all times professors and instructors with extended experience in electrical engineering, all of whom come into intimate contact with their pupils. The school was founded by Prof. Oscar Werwath, who has remained at its head steadily from the modest start in 1905. Prof. William Baum, who was for a long time associated with Dr. Charles P. Steinmetz, is dean of the Engineering Department. John D. Ball, for many years with the General Electric Company, and for three years in the research laboratory of Dr. Steinmetz, is professor of electrical engineering. H. D. Matthews, formerly with the General Electric Company, is professor of electrical design. A. E. Kienth, formerly in charge of water purification and bacteriology for the city, directs the work on industrial chemistry. The instructors in electrical work include Fred C. Raeth, B. A. Bovee, J. P. Schroeter, Walter Hennig, R. A. Tamms and J. E. Hughes.

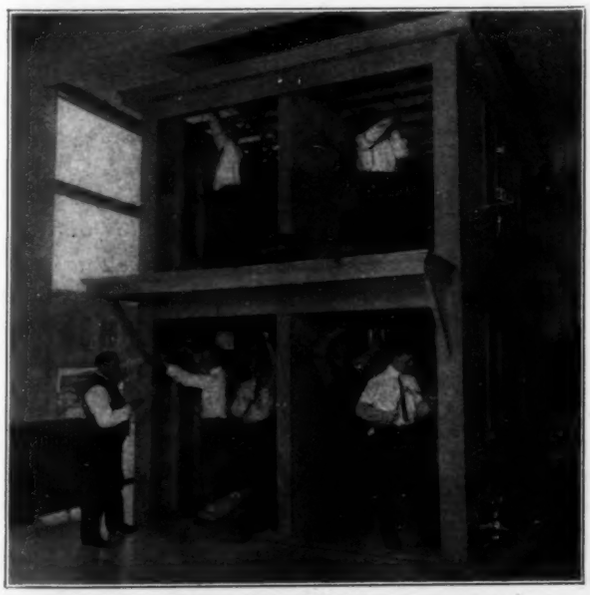
Early this year the school greatly increased its

facilities and broadened the scope of its work. Enlarged quarters were secured for the Engineering Department in the Insurance Building and the equipment thereof is now practically all complete. Arrangements are being made for a special class in radio and other signal work in co-operation with the Great Lakes Naval Training Station.

The school was also fortunate in securing as business manager and director of engineering and industrial relations, the able services of Francis A. Vaughn, senior member of the well-known consulting engineering firms of Vaughn & Meyer and Charles L. Pillsbury Company. Among the developments that Mr. Vaughn has brought about or is working on are: Bringing the school into closer co-operation with large industrial and business concerns of Milwaukee; establishment of the special Navy Signal School in co-operation with the Navy Department and the telegraph and cable companies; organization of a commercial testing bureau; arrangements for making the library of the school a technical library open to Milwaukee's industries and others interested in technology; completion of plans for conducting at the school an electrical show from March 27 to 30. At this show about 20,000 square feet of floor space will be available for exhibits, which it is expected will be of unusual and timely interest, since they will include much in the way of electrical equipment used in the war. Numerous popular lectures and talks and motion-picture displays will be given, so that a large attendance is to be expected, everyone being invited.

Some Features of the School's Equipment and Work.

In the accompanying illustrations are shown a few views in some of the electrical laboratories of the school. These give a better idea of the practical nature of the equipment and training given than could be described in the limited space available. A noteworthy feature is an actual transmission and distribution pole line with regular equipment which was presented to the school by the Milwaukee Electric Railway & Light Company. With this equipment students can obtain an excellent practical idea of the work of a lineman. Other equipment is also provided for testing meters,



Teaching House Wiring in a Model House.

Portion of the Dynamo and Motor Laboratory.

telephone switchboards and circuits, dynamos and motors, for study of armature winding, for ordinary and special electrical measurements, as well as the great variety of experiments usually conducted in electrical laboratories of educational institutions. To economize the time of the students, the equipment is so arranged that the time that is usually wasted in making connection of parts and instruments is greatly reduced. This also reduces the wear and tear on the apparatus.

In taking up the practical study of an instrument or apparatus, its parts are studied in detail and assembled into a complete unit at the same time that the theory of its construction is studied. This method is followed, for instance, in the study of telephone instruments, switches, motors and generators, etc. The student is taught to assemble and disassemble the apparatus in order to locate and remedy troubles. In classrooms adjoining the laboratories, the explanatory work and discussion of the results of the tests is given.

Among the companies with which co-operation is actively carried on in part-time employment of students are the following well-known Milwaukee electrical concerns: Allis-Chalmers Manufacturing Company, The Milwaukee Electric Railway & Light Company, Julius Andrae & Sons Company, Industrial Controller Company, Allen-Bradley Company, Globe Electric Company, Northwestern Storage Battery Company, Wisconsin Telephone Company, Northwestern Manufacturing Company, Lime Material Company.

WAR COURSES LAUNCHED AT CARNEGIE INSTITUTE.

Special electrical war courses for enlisted men are being given at Carnegie Institute of Technology, Pittsburgh, Pa. Instructors are wanted to teach the following subjects; lectures and laboratory work in elementary electricity and magnetism. Same for dynamo machinery, storage batteries and radiotelegraphy. Others are needed to teach continental code, practical electric wiring, instrument repair and machine work. The Institute is especially desirous to hear from a few instructors who would come for short periods, two to six months. State age, draft status, qualifications, schooling, experience, references, salary expected and period of employment desired in first letter or telegram. Address Chairman of War Course Committee, Carnegie Institute of Technology, Pittsburgh, Pa.

Editorial Comment

Daylight Saving

ON March 19 President Wilson signed the daylight saving law, which will come into effect on March 31. The law provides that at 2 a. m. on the last Sunday of March of each year the standard time shall be advanced one hour, and at 2 a. m. on the last Sunday of October standard time will be retarded one hour. The period for daylight saving is thus of seven months. Although shorter than that more lately proposed by Samuel Insull and a number of noted engineers, economists and utility men, who proposed that the clock be advanced one hour for the entire year, the law as signed by the President is for a period longer by two months than the bill passed by the Senate last year, which called for five months of daylight saving. However, a start has at last been made. Another step has been taken in the thrift movement, and who shall say what will be next, or where the movement will end?

In adopting daylight saving the United States is doing only what her allies, the French, British and Italians, have already done for one or more seasons. And the allies have done only what the Germans had done before them, for Germany adopted daylight saving on May 1, 1916. Austria, Italy, Holland, Denmark, Norway, Sweden and Portugal then followed. France and England came next, although a daylight saving bill had been pending in the British parliament since 1908, and now finally the United States follows suit, the country credited with having been the first to sponsor the cause of daylight saving through its noted citizen, Benjamin Franklin, over a century ago.

There are probably few pieces of legislation possessing so many advantages and so few objections for the nation and so many benefits and so few hardships for the individual as this daylight saving law. The law aimed primarily to conserve coal, and this it will do to the extent of about 300,000 tons this year, and more as the users of electric light become more numerous. For electric light customers the daylight saving will, it is estimated, save about $7,500,000 this year, an amount that will, however, affect but little either central station or consumer. For the central stations this hour of daylight saved will mean a reduction of income, so small in most cases, except where the lighting load is the predominating source of revenue, as to be masked by increased revenue in other ways; it will mean a reduction of the magnitude and duration of the peak and thus will reduce the amount of coal required for banked fires and consumption at forced ratings with accompanying higher maintenance expense. It will mean a higher load-factor, thus enabling investment in equipment to be better utilized, bringing in higher return. Unfortunately the winter peak still remains, and until this is removed entirely or in part, as possibly some day it may be, there must necessarily exist a waste of equipment and fuel, and higher rates for energy than there would be otherwise.

But as important as are these benefits of daylight saving, more important still, perhaps, is the effect of this additional hour of daylight upon the improvement of health and increase in food production. The extra hour of daylight will give to many more time for recreation. It will mean more of God's great outdoors for the indoor toiler, park or field or street instead of indoors with its things artificial. It will mean better health physically, mentally and morally for many, and more joy for most. This extra hour of daylight will mean greater production by the soil. It will mean more time in the fields and orchards for sowing seed, cultivating crops and reaping the harvest. It will mean more food and better health for those serving the country by obtaining it. This extra hour of daylight will be a boon indeed for the war gardens and the home garden of the city horticulturists. In this sense alone it has been estimated that during the coming summer more than 1,480,000,000 daylight-hours will be added to the backyard and vacant lot cultivation alone, which must add its quota toward increasing food production, reducing the cost of living and amount of truck transported, as well as encouraging outdoor life and the home garden.

The daylight law will conserve coal, increase home food production and improve health; it will improve the hours of leisure for many, and thus better their work during the hours of toil. The daylight saving law comes with universal welcome. The only surprise is that it has taken so long to come, that the country responsible for its original promulgation should have been the last of the big nations to adopt it, and then only under the stress of war. However, the sun is with us now, to "do its bit" toward winning the war.

Banking Distributing Transformers

THE question of whether distributing transformers should or should not be operated in parallel is an old one, that appears again at this time with renewed interest, when effort is being made in all walks of life to economize. The question is not new, only conditions have changed, and better facilities and wider experience are available today than existed ten years or so ago to overcome past difficulties and minimize inherent drawbacks of a number of transformers operating into a common network.

Circumstances alter cases, and each case of transformer banking for distribution purposes must be de-

cided on its own merits. In every instance it is a matter of deciding whether the advantages—conservation of transformer capacity, lower unit cost for transformers, lightning arresters and secondary copper, and more efficient transformation and distribution and higher standard of service—are not offset by the disadvantages of having a number of units tied in together. The question also to be decided is whether it is better for service as a whole to have each transformer isolated and trouble thus localized or whether it is preferable to tie in a number of transformers in such a way that one unit in trouble will clear itself and shunt its load over to those that remain; and before this question can be settled it is necessary to know, approximately, how often cessation of power on the one hand or variation from the normal on the other is likely to occur, and which is the more objectionable, occasional cessation or frequent fluctuations due to trouble in a bank.

For many years network protectors have been available to restrict the interchange of energy between portions of an interconnected network, somewhat analogous to the bus reactor to limit the current flow between bus sections and generators. But these, like the secondary fuse recommended elsewhere in this issue in an article by E. M. Grah for protecting the transformers in a banked group from carrying excessive load during time of trouble, are a further complication, add to the cost of the installation and thus detract both from the saving and advantages advanced for banking distributing transformers.

Undoubtedly there are cases where banking transformers is feasible, quite desirable and to be recommended. One such instance that suggests itself might be that of the smaller city where the load is light yet dense and its growth stable. The two extreme cases where banking might not be desirable nor justifiable, the one for economic reasons, the other from considerations of reliability to service, are where the load is widely scattered on the one hand and extremely dense and heavy on the other.

Transformer banking, like the grounded neutral, three or four-wire three-phase distribution, direct or alternating current for railroad electrification has its place, which may or may not be sharply defined but nevertheless exists. Only consideration of safety, reliability of service and economy will indicate the final choice. While a number of systems with interconnected or banked transformers are in successful operation, the weightier opinion is undoubtedly against banking.

Greater Publicity for Electric Vehicles

THERE are enormous possibilities for the use of the electric truck. Possibly even the most optimistic central-station and electric vehicle companies do not as yet realize the wide diversity of applications, the vast field that the electric vehicle is well fitted to fill. Co-operative trucking, fleets of transports for bulk freight haulage, armies of express wagons, and so on—these are opportunities, but are in the minority. What of the really big demand that exists, and which as yet is only catered to by the gasoline car?

Consider the case of grocery deliveries alone—only one out of many similar branches of delivery and transportation—which is vitally interwoven with the high cost of living and the sustenance of the people. It has been estimated that $75,000,000 is spent annually in the delivery of groceries throughout the country. And then there are other retail deliveries such as milk, coal, meat, hardware and laundry, without mentioning all the wholesale hauling and trucking and municipal and industrial transportation. The Census Bureau found that while the cost of department-store deliveries was less than 2 per cent of the total cost, that for milk and dairy produce was 12, for coal and wood 19, and for ice delivery 45 per cent of the total cost. This all has to be borne by the consumer and partly accounts for the excessive cost of living.

Notwithstanding all the progress made by the electric vehicle, the evolution and improvements through which it has passed, figuratively speaking, nothing has seriously been done in applying the electric vehicle to general usage. If the electric truck is to find the use its sponsors desire, that its merits warrant, and economy demands that it should, operating data and its low cost of upkeep and operation must be placed prominently before the public, which comprises user, prospective user and future possible user. Not long ago the Society for Electrical Development issued a pamphlet entitled "More Than 3000 Uses for Electricity." How many uses are there, in actual usage and prospective, for the commercial and municipal electric truck from a few hundredweight to 10 tons, for high speeds and the heavy short low-speed haul? More than many suppose.

A compilation of uses for the electric truck—not war-time measures, transient uses and spectacular applications, for these will take care of themselves—but the commonplace everyday variety of uses, such as garbage and dust collection, milk and coal distribution, delivery of groceries and laundry, and the many other things that enter into everyday domestic and commercial life, that go on whether comes peace or war, with cost data and comparisons of expenditure of capital, time and labor for gasoline and horse, would plead the cause of the electric truck as nothing else would.

Operating costs are the final criterion between horse, gasoline or electric truck. On this basis alone the electric truck is able to hold its own against all comers in an increasingly widening field. But that this is so is not generally known except amongst those who have studied the subject. It certainly is not known by the everyday truck purchaser. The merits of the electric truck deserve that they be advertised wisely and effectively. The high cost of living and the best interests of all require that this be done. And be done now.

Week's Events

Electric Hoist Facilities Offered Government—Electrical Manufacturers Meet — Minnesota Water Power Survey

MINNESOTA ASSOCIATION ELECTS OFFICERS.

Convention Held at Minneapolis Establishes New Attendance Record—Many Interesting Papers.

In spite of war conditions, or rather because of them, the attendance at the annual convention of the Minnesota Electrical Association was the largest in the history of that organization. The meeting was held at the Hotel Radisson, Minneapolis, Minn., on March 11, 12 and 13, and the program provided many topics of timely interest bearing especially on wartime utility problems.

A brief report of the early sessions was presented in last week's issue. Papers were presented by S. B. Hood, George A. Hughes, George Hewitt, Prof. W. T. Ryan and R. D. Thomas.

Officers for the ensuing year were elected as follows:

President, B. W. Cowperthwait, assistant general manager Northern States Power Company, Faribault, Minn.

Secretary-treasurer, F. C. Hoffman, auditor, St. Paul Gas Light Company, St. Paul.

Vice-president, H. E. Swanson, superintendent, Water & Light Board, Rochester, Minn.

Directors: The above three officers and the following: H. E. Young, sales manager, Northern States Power Company, with headquarters in Minneapolis; Emil Aveldson, superintendent, Municipal Electric Light Plant, Litchfield, Minn.

The next convention will be held in St. Paul.

Resolutions expressing loyalty to the government and declaring for a program of conservation in the interests of the successful prosecution of the war were adopted.

Mr. Cowperthwait, the new president, is one of the best known utility men in the state, and the Minnesota Electrical Association will have in its new president a man of wide experience in the industry.

ASSOCIATED MANUFACTURERS OF ELECTRICAL SUPPLIES HOLD ANNUAL MEETING.

General Association Meeting on March 21, Together With Numerous Section and Committee Meetings Throughout the Week.

The various sections and committees of the Associated Manufacturers of Electrical Supplies are meeting in New York City this week with a large attendance. Business sessions have been held every day at the association's rooms on East Forty-second street. The annual meeting for the presentation of reports, considering trade conditions after the war, trade acceptances, the election of officers and other matters was held on Thursday. The afternoon session was in the nature of a business meeting. At the evening session which followed a banquet at Delmonico's, topics of timely interest were presented; Maj. Donald Guthrie of the British army was one of the principal speakers and described some of his personal experiences on the battlefront in France.

The association includes in its membership the leading electrical manufacturers of the United States, comprising about 200 makers of electrical goods. Present officers are H. B. Crouse, president; A. W. Berresford, vice-president; J. W. Perry, treasurer; Charles E. Dustin, secretary; Thomas M. Debevoise, counsel.

Practically all the sections and the chief committees of the association held their own separate meetings at various times during the week, these sessions being in the nature of conferences where topics of detailed interest to the various classes of manufacturers were discussed. Nearly 20 such section and committee meetings were held between Monday and Friday afternoons. A more complete report of these meetings will be given in our next issue.

ELECTRIC HOIST MANUFACTURERS OFFER FACILITIES TO GOVERNMENT.

Form Association to Co-ordinate Activities and Secure Standardization.

The Electric Hoist Manufacturers' Association has, by a resolution adopted at its last meeting, offered the services of the member companies to the Government in meeting the extraordinary demand for their product.

The War Industries Board of the Government has requested full information concerning the ability of the electric hoist manufacturers to handle the volume of business offered them.

It is evident that the association will be of great assistance to the War Industries Board, as it is becoming more apparent from day to day that there are numerous advantages for all concerned to have manufacturers in certain lines organized, especially now, in the hour of the nation's greatest need, and instead of vindictive competition and antagonism along business lines, the spirit of co-operation and exchange of ideas, looking toward increased output, should prevail.

Electric hoists for shop use and handling material have gone through various stages of development during the past 15 years, and like all classes of shop machines, they cannot be successfully designed on the basis of theory alone. Actual experience in meeting hoist requirements and innumerable corrections and refinements in design on the part of the manufacturers have marked the progress made during these past 15 years in this important field.

The many mistakes, both on the part of the manufacturer and the user during this development period have in some instances created a lack of confidence in electric hoists as a class. On the other hand, many users have been led to believe that such hoists are un-

affected by abuse and can consistently be called "fool-proof."

Some discredit to these machines has developed on account of lack of standardization in nomenclature, service rating and general characteristics on the part of the makers.

Now that it is thought that the experimental stage has been well passed and acceptable designs developed by various manufacturers, it seems wise to co-ordinate the total experience and to make available for the user, all that is best in electric hoist design and practice. With this object in view, the manufacturers of the United States organized "The Electric Hoist Manufacturers' Association," comprising the following companies:

Brown Hoisting Machinery Company.
Detroit Hoist & Machine Company.
Euclid Crane & Hoist Company.
Franklin-Moore Company.
Link-Belt Company.
Roeper Crane & Hoist Works.
Shepard Electric Crane & Hoist Company.
Sprague Electric Works.
Yale & Towne Manufacturing Company.

The officers of the Association are as follows:

F. H. Hatch, chairman, Shepard Electric Crane & Hoist Company.

F. W. Hall, vice-chairman, Sprague Electric Works.

C. W. Beaver, secretary-treasurer, Yale & Towne Manufacturing Company.

The Association holds monthly meeting for the purpose of studying the specific needs of the hoist user and to develop standardized methods of presenting information to him so that guess work will be eliminated.

The association will consider uniform nomenclature pertaining to the types and parts of electric hoists, fix upon a standard by which hoist motors shall be rated and promote the standardization of electric hoists as far as possible. It will also collect and disseminate information and statistics relative to the electric hoist industry, provide facilities and opportunities for study and education in regard to the economics of the industry, extend the use of their product by pointing out the great number of material-handling problems of different classes that can be solved by the use of electric hoists, promote a friendly intercourse and co-operation among the members.

NATIONAL HEADQUARTERS OF CONTRACTORS AND DEALERS MOVED TO NEW YORK.

The organization headquarters of the National Association of Electrical Contractors and Dealers have been removed from Utica, N. Y., to New York City. A suite of rooms has been secured in the World's Tower Building. The headquarters of the association have been in Utica since it was first organized as the National Association of Electrical Contractors of the United States. Since the reorganization and expansion of the association, which took place in the last few months, it has been thought desirable to move the main offices to the country's metropolis, so as to make it easier for the many visitors of national prominence to visit the offices without a separate side trip. The address of the new office is Room 1703, 110 West Fortieth Street, New York City. Harry C. Brown is secretary of the association, and W. C. Peet is national chairman.

SURVEY OF MINNESOTA WATER POWERS.

Only 113,000 Horsepower Developed Out of Available 750,000—Low Heads Predominate.

In an address before the recent convention of the Minnesota Electrical Association, R. D. Thomas, superintendent of the St. Anthony Falls Water Power Company, pointed out conditions in Minnesota with particular reference to the low heads and wide variation in the flow.

Few, if any, of our Minnesota rivers have been developed hydraulically to the maximum degree possible as is evident from figures published by the State Drainage Commission in which it is stated that there is a total average development of 113,000 horsepower out of an estimated available horsepower of 750,000.

The majority of the plants utilizing water power were built primarily for local manufacturing purposes and are still devoted largely to the operation of pulp and paper mills, saw mills, and flour mills. In fact the early history of water power here, as well as elsewhere, is most intimately associated with the development of the two latter industries.

The introduction of electricity as a means for developing and transmitting power over considerable distances and the rapid development in its adaptation to a variety of uses has brought about a complete change in the status of water power. Formerly this power was used only at the immediate point of its availability and many remote and inaccessible powers have been useless and of no value commercially. Today these powers have become available in convenient form and we find the tendency of all hydraulic power developments to be in the shape of hydroelectric plants and, incidentally, the state is becoming already a network of transmission lines. Electric lights and electric motors are no longer found only in our cities but many farming communities have now come to look upon them as necessities of country life.

All of this tends to enhance the value of our water powers, but on the other hand there are many causes which tend to retard hydroelectric development, some of which will defer the complete utilization of these resources for an indefinite time.

Contrary to a common idea all potential water powers are not commercially feasible prospects and with the rapid improvement in the efficiency of steam-producing machinery there has arisen a very decided competition which must be reckoned with in all our studies of the proposed development.

Generally speaking, hydraulically developed power is inferior to that generated by steam. It is usually dependent upon rainfall and other variable factors over which man has no control. The initial cost of development is relatively high; and it must compete with steam power which is actually today, on the basis of pre-war fuel prices, being producer, where the large steam turbine is used in thoroughly modern plants, at a less cost per kilowatt-hour than is possible by water power in any but our most favorably situated hydroelectric plants.

To offset the handicaps of seasonal variation in stream flow, complete or partial interruption by drought or ice, the menace of floods and the annoyances experienced in long distance transmissions to say nothing of the impediments of improperly considered state and federal legislation, a fair chance of reasonable return on the investment must be assured before the conservative and discriminative investor will risk his money on hydroelectric development.

Minnesota water powers are frequently seriously handicapped by those extreme low-water conditions attending our more severe winters when long periods of sub-zero weather occur. The low-water flow attending low temperatures may be, and generally is, quite independent of precipitation.

Occurrences of this nature impress upon the public service manager and upon the designing engineers the need of utilizing to its maximum degree of efficiency every cubic foot of water available for power purposes. This need is still further emphasized by the present emergency in fuel supply when coal is not only excessively high in price but also most difficult to get. Most of our hydraulic power plants in Minnesota are antiquated and inefficient. Even many of those built within the last few years are so inefficient, according to present standards, that they could profitably be remodeled on modern lines. Progress in water-wheel design and the development of improved settings has been so rapid that only the most recent plants attain the best efficiency possible.

Contrary to the general belief of the public, a water-power development is a continual source of heavy expense to its owners. Its very nature is such that it is exposed to the most destructive forces of the elements which batter away unceasingly day after day, and year after year, until eventually some weak spot is found by ice or flood and in perhaps a few hours the earnings of years are lost.

To prevent this possible ultimate loss, eternal vigilance is necessary and repairs and renewals must be made as the need arises. This system frequently requires expenditures that are difficult to make but the highest economy demands that they be made even, as is frequently the case, at the cost of great sacrifices elsewhere. In spite of these uncertain elements and the keen competition of steam power in the past, water power is today a most essential factor in our power problems.

The present high fuel costs and transportation difficulties have made it desirable and even necessary to use this resource to the ultimate possible limit. The Federal Government is now taking steps to promote economic water power development and Congress will probably, at an early date, pass a bill now pending which will result in increased activity in this direction.

ELECTRIC FURNACE FOR NON-FERROUS METALS.

Discussion Before Lynn Section of American Institute of Electrical Engineers.

On the evening of March 13, G. H. Clamer of the Ajax Metal Company, Philadelphia, gave an illustrated lecture on the electric furnace as a means for melting the non-ferrous metals and alloys. One of the great troubles in the early experiments with the open-ring furnaces was with what is termed the "pinch effect" which results when high density currents are passed through a molten conductor, whereby the conductor tends to contract. If the current be sufficiently increased, this contraction proceeds to such a degree as to pinch the conductor so that the circuit becomes entirely interrupted.

Mr. Clamer, in speaking of the electrical reason for the "Pinch effect," showed that conductors carrying current surrounded by lines of force having the same direction, repel each other; those of opposite direction attract each other. Therefore two conductors placed parallel and carrying current in the same direction will be attracted to each other. If we consider a molten conductor as made up of numerous conductors parallel to each other and carrying current in the same direction, it will be seen how the molten metal will be attracted to the center of the conductor and will actually set up a pressure there. This has been scientifically designated by Dr. E. F. Northrup, who has thoroughly worked out the mathematics of the electric furnace, as the "internal pressure effect."

Before describing the Ajax-Wyatt furnace and differentiating between the pinch and motor effects, Mr. Clamer gave a description of electric furnaces in general, with particular reference to the closed channel induction furnace invented by Charles P. Schneider, president of the Creusot Steel Works of France, which is described in two patents granted in 1904.

In connection with the advantages of the electric furnace, the restriction of its field of usefulness was shown in that it can be operated to advantage only in continuous service, and is not economical on an 8 or 10-hour basis.

The Ajax Metal Company began by building small sizes, but found that as the sizes of furnaces increased, the troubles did also. Some 50 experimental furnaces were built and over $100,000 expended before there was assurance of commercial success.

Though there is much development work yet anticipated, the lecturer concluded with an expression of belief that the electric furnace is the ultimate type.

SIGNAL CORPS HAS OPENING FOR MANY ELECTRICAL MEN.

Required for Various Branches of Radio Communication Work.

The Signal Corps, U. S. Army, has announced that it can use the services of a large number of men having electrical training. They are needed especially in connection with the radio-communication systems in use in the military service. All classes of electrical men—wiremen, expert electricians, storage-battery men, telegraph and wireless operators, and men with electrical-engineering training and experience are wanted. The opportunity offered is exceptional because of the great interest and importance of this branch of the service which has been most aptly characterized as the nerve system of the army. Men engaged in the radio division of the communication work in particular have an increasingly important part in the great intelligence system upon which army operations are almost totally dependent. The scope of this work requires men who will fall in general into three classes, depending on the character and amount of experience had by the individual, namely, radio operators, radio mechanics and field radio experts.

Application blanks for service in the radio work of the Signal Corps may be secured by addressing the Office of the Chief Signal Officer, Land Division, Training Section, Washington, D. C. Men of draft age may make application and if qualified will be inducted into the army, at their request, for service in this branch of the Signal Corps. After enlistment or induction, all personnel will be sent to one of several radio schools for six weeks to three months of intensive training in the one of the three general branches of the radio work for which their previous experience qualifies them. Some of the personnel completing these courses will be commissioned, and the opportunity for advancement for all graduates will be dependent on the individual ability.

Commercial

Silk Lamp Shades Entice Lamp Buyers—Customers' Demand and What It Means—Electric Motors for Sheep Shearing

SILK LAMP SHADES ENTICE LAMP BUYERS.

W. E. Quillin, Lorain, Ohio, New Business Manager, Utilizes Women's Natural Needle Skill to Make Sales.

There are many persons who cannot see the usefulness of a portable electric reading lamp unless it be from the decorative possibility. To such critics—and among them are found many central-station men—a 100,-watt lamp in an indirect ceiling fixture is worth infinitely more than the small portable lamp that can be of use but to one person at a time, as a rule.

But the portable lamp by reason of possessing these qualities can be a great consumer of current, and consequently should be viewed favorably by the central-station man.

W. E. Quillin, new-business manager of the Lorain County Electric Company at Lorain, Ohio, has discovered a profitable way of helping this tendency along. Silk lamp shades appeal to the decorative tastes of most women, but the expense often balks them. Mr. Quillin solved this by instructing the women in the art of making their own silk shades. He obtained a young woman of Lorain with needlework abilities and sent her to a needle school in Cleveland. When she returned he opened a department of instruction for home silk shade manufacture. The company laid in a line of wire frames, silks and braids so the pupils could buy the materials at the place of instruction, and success was immediate. There are now as many as 30 women in the Lorain County Company's office in one afternoon buying material and working on shades. Purchases of lamps to fit the shades have been numerous. The instructor makes shades for the company during her spare time.

ELECTRIC VACUUM CLEANER OPPORTUNITIES.

Spring House-cleaning Season Is Time to Make Demonstrations and Push Sales.

House-cleaning and sanitation suggestions are pertinent at all seasons, but are especially so at the opening of spring when the home needs renovating to rid the rooms, closets, carpets, floors, walls, ceilings and furniture of the unsanitary accumulations of the winter. When the warm sun brings budding shrubs and we let the springtime atmosphere sweep through the rooms we don't want it vitiated by dusty rugs, musty walls nor cobwebs in the corners. And to accomplish this it should not be made necessary for the housewife and her helpers to undergo an excruciating experience with scrubbing brushes, mops and brooms.

It is within the province of the electrical contractor-dealer to make such demonstrations as will result in steadily extending the use of the electric vacuum cleaner in the home, and thereby banish the old-time drudgery identified with house-cleaning time. It is up to the appliance dealer to show home owners that there is economy of money and time, and conservation of health in the work of the vacuum cleaner; that, in logical sequence, it follows the electric stove, washer, and ironer in the complete electrification of the home. To demonstrate the utility and positive benefits of such appliances is opportune at all times, but the opening of spring is especially the season for the sale of the electrical cleaner, that helps so much to lighten the burdens of household work, that makes of electricity the ever-ready and tireless servant.

As an example of organized effort in pushing the sale of electrical appliances, and especially of vacuum

SPECIAL SALE OF

RELIABLE-ROYAL VACUUM CLEANERS

15 DAYS ONLY.

HERE at last is our electric cleaner at a price YOU can really afford. Staunch and sturdy little dust and dirt gatherers that weigh but eight pounds; can be carried all over the house in one hand; picks up those tantalizing threads, lint and hair with their friction driven brushes.

OUR GUARANTEE

We absolutely guarantee every "Reliable" and "Royal" against all defects in workmanship or material, and will replace free of charge, without question, any machine found defective.

We have on hand a few demonstration Vacuum Cleaners which we will sell at Bargain Prices.

Phone Main 2950, and ask for free demonstration in your home.

NEW ORLEANS RAILWAY & LIGHT CO., 201 BARONNE ST.

Circular Distributed by New Orleans Company in Vacuum-Cleaner Campaign.

cleaners, the New Orleans Railway & Light Company is pursuing a plan worth noting. Its spring campaign of demonstrating and selling electric cleaners is now well advanced in that latitude. The Reliable and the Royal are the types being sold. Both the efficiency and the price of these machines are brought to the attention of patrons in several ways which are found effective. A little folder called "Service," of which 30,000 copies a week are circulated, carries the illustrations, descriptive, guarantees and announcements concerning electrical appliances; and recently much of this attention has been centered on vacuum cleaners. Similar stories are told by means of bill stickers, on which special sales of Reliable-Royal cleaners are announced. A copy of a typical sticker is herewith reproduced.

Patrons who have purchased appliances of the company at some previous time are listed as preferred customers, and in addition to sending them literature, they are communicated with over the telephone by a young woman whose duty it is to arrange appointments whereby demonstrations of vacuum-cleaner work may be made. This method has been found to be specially helpful in disclosing leads to genuine prospects. Advertising spaces in newspapers and street cars are being utilized and house-to-house solicitations and demonstrations bring in a share of the results. Thus, the store displays, house organ publicity, sticker announcements, telephone talks, local advertising and salesmen's work, all combined, probably reach most of the possible customers. This electric vacuum cleaner work is taking a strong hold on the American home.

LAST GASOLINE ENGINE REPLACED BY CENTRAL-STATION SERVICE.

What is thought to be the last gasoline engine operating in Momence, Ill., has been displaced by an electric motor, thus ending a campaign of the Momence Utilities Company to electrify all establishments using power other than electric.

The Momence Utilities Company, Momence, Ill., has been operating a plant and delivering power and light service in a restricted territory for a number of years. Its field comprises, Momence, Grant Park and the surrounding farming community. The country region is served from 10 miles of line. There are 670 meters on the system, 70 having been added in 1917. The power business is represented by 425 horsepower in connected motors in Momence and Grant Park, the largest user of power being the Tiffany Enamel Brick Company at Momence, which takes 200 horsepower. Selling electrical appliances is an important adjunct to the business. About 40 electric ranges, 400 flat irons and a number of washing machines and vacuum cleaners are in use in the territory served. In the farming districts, in addition to lighting service, the use of motors for pumping and domestic utilities has been considerably extended.

POWER DEVELOPMENT AT STREATOR, ILL.

Central-station power service at Streator, Ill., amounts to approximately 250,000 kilowatt-hours per month, being distributed to industrial plants as follows: Western Glass Works, 100,000; Streator Clay Manufacturing Company, 60,000; American Bottle Company, 60,000; Streator Brick Company, 17,000 kilowatt-hours.

CUSTOMERS' DEMAND AND WHAT IT MEANS.

A Power Salesman's Explanation of the Elements Which Enter Into Rates for Energy.

By T. D. Rose.

Consolidated Gas, Electric Light & Power Company, Baltimore.

The demand, as defined in our rate schedules, "is the greatest amount of electricity normally used by the customer at any one period of time." In selling electricity, then, our company wants to know three things about every customer's load: the total amount of energy consumed, the normal maximum rate at which that energy is taken from our lines, and the time at which that maximum occurs. We can all readily see why an actual knowledge of the total amount of energy used is necessary, just as we can understand why the merchant must know how much of any commodity he sells us, but we cannot so easily understand why a knowledge of the maximum demand, and the time that it occurs, is necessary before any charges can be made.

In any form of business requiring invested capital two separate and distinct forms of charges are made on the books to properly account for expenses. These are fixed charges and operating charges. The fixed charges are usually defined as those charges which are not a direct function of the amount of product manufactured or the amount of business done, but which are concerned with providing the working equipment. These charges remain whether the plant or business produces or not. On the other hand, the operating charges are defined as those charges which are a direct function of the amount of product or the amount of business and which are concerned solely with the actual production. In some cases a third form of charge is made, called the consumers' charge. Under this head are placed those costs which are not concerned with providing a working equipment and which are not a direct function of the output, but which are dependent upon the number of consumers.

The fixed charges are those costs which are concerned with providing the working equipment or physical properties of a company. Under this head are included such items as interest on investment, depreciation, rentals, taxes, insurance and certain general office expenses. These costs all remain independent of the amount of business done.

The operating charges include such items as labor in plant, supplies in plant, repairs, advertising, cost of new business and general office expenses. These items are all dependent upon the amount of output.

Under the consumer's charges are costs of billing and collecting, and in the case of central-station companies, the cost of meter reading. These items are all functions of the number of consumers on the books. However, this classification is usually included under fixed charges, because they are not in any way related to the amount of product manufactured and sold.

Thus we see that central-station companies have two separate and distinct divisions of cost, of which each customer should pay his proportionate share. The items in one division are dependent upon investment required to serve each customer and the items in the other division dependent upon the number of kilowatt-hours furnished each customer. This, then, forms the basis of our method of charging.

Demand Determines Investment.

We have seen how the greatest amount of electricity normally used by our customers at any period

of time fixes for us the capacity of our generating plant and distribution system, and hence determines for us the amount of money that we must invest. We have also seen that there are certain expenses which are not a part of the actual cost of producing and selling energy, but which are dependent upon our readiness to serve. A certain part of our investment and a certain percentage of our other costs are therefore literally held in readiness to serve the customer at any time that he might demand that service. All of these expenses added together and divided by the capacity of our plant and distribution system give us a figure of so many dollars per kilowatt of capacity that is at the service of each customer.

Since, as shown above, the sum of the coincident desires or demands of all of our consumers determines for us the capacity of our system, and since each unit of capacity costs us a stipulated amount to cover fixed charges and readiness to serve charges, which are entirely independent of the number of kilowatt-hours sold, each customer must pay his share of those costs, the total amount of which being dependent upon the amount of each customer's demand. It is very essential, therefore, that we know the greatest amount of electricity that each customer normally uses, since this gives us the amount of equipment we must have in readiness to serve him and furnishes us with the data to properly charge him for his share in the fixed charges.

Determination of the Load Curve.

Every class of customers, whether it be residences, apartment houses, stores, office buildings, or the various forms of manufacturing plants, has its own characteristic form of load. This characteristic is formed by the habits of the people or the conditions of the business. Every little load has a shape that is all its own. The sum of all these loads makes for us the shape of our own load curve. At a certain time of day on each particular load, we find a maximum and if all of these maximums occurred at the same time, the capacity of our system would have to equal the sum of all these maximums. Luckily, however, different people have different habits and different businesses have different characteristics, so that the maximums of all classes or the demands of all customers do not come at the same time.

However, the habits of a certain number of people and the characteristics of a certain number of businesses do coincide, so that at a certain time every day a sufficient number of maximums occur at the same time to produce for us what is called our peak. This peak varies, of course, with the weather and with the seasons. A cloudy day demands more artificial light, a short day in the winter demands earlier light and heavy seasonal business in industrial plants demands more power. Thus we see that at a certain time every day our station has its greatest load or peak.

Equipment Must Take Care of Peak.

In order to meet this peak whenever it comes we must have sufficient generating, substation and distribution capacity, and, therefore, the amount of the peak and its duration fixes for us the size of system. This equipment must be provided whether the peak is for one hour or ten hours. In practice, however, it seldom lasts longer than one hour. At any rate, one hour is the basis for making this peak determination.

This means that when we provide sufficient equipment for that peak, a certain amount of that equipment must be idle during other parts of the day. Or, in other words, only for a short time every day is our entire investment working, that time being more or less fixed for each day in the year. It follows, therefore, that it costs us more to serve a customer whose maximum demand occurs at the same time when our peak occurs, than it does to serve another customer whose maximum demand occurs at some other time of the day. Hence our reason for desiring to know the time at which every customer's maximum load occurs.

We see, therefore, that we must know the amount and the time of each consumer's demand because they fix for us our investment. Knowing these two things about each customer's load, we can call upon each one to pay his proportionate share of the fixed charges on that investment.

MOVING PICTURE THEATERS AS LOAD BUILDERS.

The Consumers Light & Power Company, New Orleans, La., has recently connected up a luxurious moving picture theater, which is probably one of the largest in the South. As indicating the possibility of this class of load, it may be mentioned that there will be 40 horsepower in motors, which will be used to drive the seven typhoon fans for ventilating purposes. These fans will vary from 5 feet to 8 feet in diameter. A 7½-horsepower motor-generator set will be used to generate the voltage for the projecting machine. The double stereopticon machine will require 50-ampere arc while the house foyer lighting will require an additional load of 10 kilowatts. There will also be a big electric sign in front of the building.

ELECTRIC MOTORS FOR SHEEP SHEARING.

An interesting installation in Public Service Company's system, at Stockdale, Ill., consists of six motors, of 53 horsepower, at the feeding and sheep-shearing station of George Weitz, situated on the Rock Island railroad. In addition to pumping water, elevating grain and grinding feed by motor power, a 5-horsepower motor is connected by a line shaft to ten shearing stalls, and in each stall a shearing machine is operated by a flexible shaft, the latter being connected by gearing to the line shaft. The shearing capacity of this outfit is 1300 head of sheep per day. Sheep are brought to this place from the western ranges. Here they are rested, fed and sheared before sending them to the mutton market. Sheep-shearing by electricity is not new at many of the big sheep ranches of the West.

CENTRAL-STATION SERVICE FOR KANKAKEE QUARRY.

The Public Service Company of Northern Illinois has contracted with the Lehigh Stone Company to supply 1000 horsepower in electric energy at the latter's new quarry and rock-crushing plant situated seven miles west of Kankakee. In order to deliver this service, the Public Service Company built a 33,000-volt, ¼-inch stranded iron wire transmission line to an out-door substation at the quarry. The Lehigh company, which has its motor-driven crushers, screens, elevators, conveyors and pumps installed, will use alternating current at 440 volts. The transformers and accessories are protected from rocks thrown in blasting by a roof.

Operating

Sleet Causes Trouble—Water-Pipe Covering—Reel Support Determining Load Center—April Street Lighting Schedule

SLEET AND DUSTY BUSHINGS CAUSE TRANSFORMERS TO BURN OUT.

Many operating companies have experienced trouble on account of dust and various kinds of dirt collecting upon the insulators and upon the bushings of outdoor substation equipment of their high-voltage transmission lines. Cement dust, the dust from deserts and foreign matter of industrial centers probably constitute the chief causes of trouble in this way. The dust gradually collects until the insulators are covered with a coating of semi-conducting matter, causing reduction in insulating properties of the line, encouraging flash-over and shut downs.

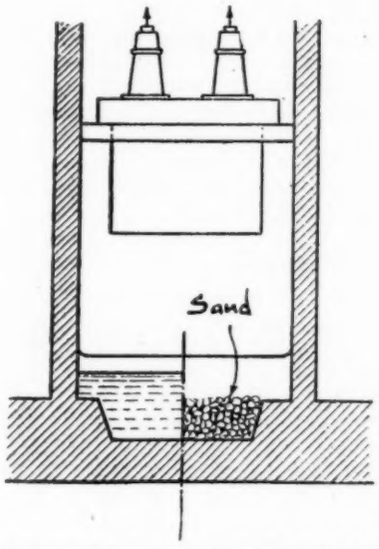
In the past these difficulties have been met in either of three ways. One way has been to shut the line down and wipe off the insulators periodically. Another has been to use duplicate lines, shutting down the one while cleaning its insulators and running off the other. In some localities, the less severe ones, it has been customary for the operating company to depend upon the fall rains to clean the insulators, thus saving time and trouble.

In one recent case of a large western power company it had been the custom to rely upon the rain in the fall. However, this last fall instead of rain the first precipitation of the season came in the form of a sticky sleet. This aparently changed the layer of dust covering the bushings of distributing transformers into fairly good conductors. The transformers were operating at 6,600 volts, and this was sufficient to cause the transformers to short-circuit across. The effect of the sleet, which would presumably not have happened had the customary rainfall occurred, was that two 20 kilowatt transformers out of a bank of three, three 7½ kilowatt transformer of a three-phase bank, one single-phase unit of the same size, and a number of smaller transformers scattered along the line burnt out. Had rain come instead of sleet the dust would undoubtedly have been washed off as in former years without causing any trouble.

OIL-ABSORBING BED FOR OIL-FILLED APPARATUS.

Much has been said at various times about fire risks of oil-immersed apparatus, the susceptability of oil-filled circuit breakers to explode, how best to safeguard them and prevent the splashing of oil should they shatter. Most of the effort in this country has been directed toward making the case of the oil switch so strong and air-tight that oil cannot be blown out except under the most severe conditions, usually the rupture of the switch. Frequently the oil switches are placed in fireproof cells, which localize the trouble and prevent damage from spreading. Rather than to employ means for permitting escape of the oil, effort has been made to restrain the internal pressures formed.

The sketch shows an oil circuit breaker installed in a cubicle. Underneath the switch and somewhat out of the way of the apparatus will be noticed a sump or drainage pit. This pit is shown filled with gravel, sand or similar absorbent material. The idea is that the sand will absorb whatever oil is splashed out of



Oil Well and Sand Pit Underneath Oil Switch.

a circuit breaker in trouble, and thus reduce the likelihood of a fire spreading, should one start. The above arrangement was one of several proposed in a recent report of the high tension apparatus committee of the Swiss Elektrotechnischer Verein.

While the use of sand in this way will probably find little application for circuit breakers the idea might perhaps be applied to transformers and transformer vaults in isolated locations and on customers' premises. A bed of sand is always useful to absorb leakage from transformers; and buckets filled with sand prove effective for fire-fighting purposes where neither thickness nor area of burning are so great as to prevent the sand from smothering the conflagration.

PIPING FOR WATER-COOLED TRANSFORMERS.

The desirable practice of covering incoming water pipes supplying cooling water to transformers is one that often causes surprise when first seen. Some companies cover these pipes with the same material and the same care that they would cover their steam pipes, although for a different reason. The covering of asbestos is first applied then a wrapping of canvas and finally brass strips are placed on at a spacing of every 3 feet.

The wrapping is not, as might be supposed, to keep heat in but instead aims to keep heat out, thus the purpose of the wrapping is the exact opposite that for which steam pipes are covered. Every degree of temperature increase of the incoming water reduces by the same amount the amount of heat absorbed by a given quantity of water. In passing through a station, which is often warm, water is often raised several degrees.

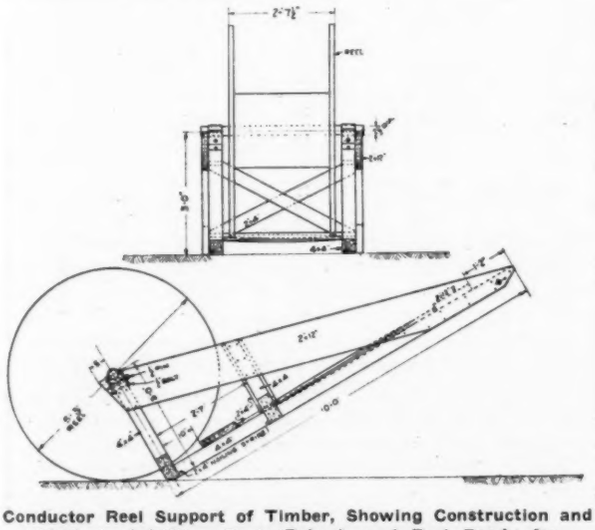
There is another reason why the pipes are covered. In summer the pipes are cold compared with the ambient atmosphere. Condensation is likely to form on the pipes, causing dripping of moisture in the station, and worse, leakage of water into the transformer.

A REEL SUPPORT MADE IN THE FIELD.

In Absence of Metal Jacks, a Reel Support May Be Readily Made with Lumber on the Job.

Cable reels should be properly mounted on some form of support so that the reel is free to revolve as the conductor is being drawn off. Moreover, some form of brake is desirable so that the drum will not continue unwinding after the conductor has ceased being drawn off, thus causing a quantity of slack conductor to unwind. Another feature in using a cable reel support is that whatever type is used it should be one requiring a minimum of attention to control, to use and permit a drum to be mounted and dismounted with a minimum effort and time. These features are particularly desirable in these times when line gangs are curtailed to a minimum, when there may be important work to be done quickly and at low unit cost.

The sketch shows two views of a form of cable reel support that will be found useful at any time, but particularly so when the ordinary jacks are absent, and makeshift methods have to be employed, where labor is scarce and it is required to lift the reel on to its mounting with least effort.



Conductor Reel Support of Timber, Showing Construction and Method of Lifting Reel (Below), and Reel Ready for Drawing Off Conductor (Above).

The reel support shown enables a heavy cable reel to be mounted without physical exertion of lifting it. Moreover, one man is able to mount a cable drum, if he blocks up the support with a piece of timber, as can be understood by referring to the lower view. The cable reel is rolled into place, the support is then tilted to the proper height, as shown in the lower sketch, so that the shaft through the drum is at the same level as the bearings of the support, and the drum just pushed into the bearings of the support. The support is then allowed to fall back into its normal position on the ground, as shown in the upper view, in doing which the reel is lifted off the ground and is immediately free to revolve. Such a drum support is readily and cheaply made up on the job with pieces of timber.

DETERMINING THE LOAD CENTER.

Differentiation Between Load Center for Voltage Drop and That for Power Loss.

By Harold Goodwin, Jr.

My attention has been attracted to the article entitled "Determining the Load Center," by C. E. Cary, which appeared on page 385, March 2 issue of the Electrical Review.

This article is interesting, but it should be borne in mind that the distance of the load as determined should be used only for the calculation of voltage drop and not for the determination of power loss. For the determination of power loss the equivalent distance of the load center from the source is always less than the distance of the load center for use in determining the voltage drop, and may vary from less than 1 per cent of the latter to more than 99 per cent, depending entirely upon the distribution of the load. For a uniformly distributed load where the distance of the load center for the determination of voltage loss is one-half of the total length, the distance of the load center for the determination of power loss is only one-third of the total length.

This difference may be very important if the limiting feature is the power loss, as was first brought out by the writer in a paper entitled "Practical Economies of Distribution," published in the 1914 Proceedings of the National Electric Light Association, and also in the December, 1914, issue of the General Electric Review. In this article it is demonstrated by calculus that for a uniformly distributed load the distance to be used in determining the power loss is one-third of the total length, whereas the distance to be used in determining the voltage loss is one-half of the total length, as generally considered.

As a matter of interest, I have determined the distance of the load center from the source for the determination of power loss for the conditions given in Figure 2 of Mr. Cary's article and submit it herewith:

Let D = total distance from source to load item.
d = distance between two adjacent items of load.
I = item of load in amperes.
i = total current in corresponding distance "d."

The total power loss will be the sum of the power losses in each section of circuit between two adjacent loads. These are equal to the current squared times the resistance of that section of the circuit. Since the resistance is proportional to the length of the circuit, and we are only interested in finding the load center, it is not necessary to know the resistance, but a figure proportional to the power loss can be obtained by squaring the current in each section and multiplying that by the length. The equivalent distance of the load center from the source can then be obtained by dividing the sum of these quantities by the total current squared. This is shown in the following table and computation. For convenience of

adding the currents together more readily, the load has been tabulated from the most distant load back toward the source, which is the exact reversal of the method that Mr. Carey used in his article:

D	d	I	i	i^2	i^2d
57	10	20	20	400	4,000
47	14	60	80	6,400	89,600
33	11	80	160	25,600	281,600
22	10	10	170	28,900	289,000
12	12	30	200	40,000	480,000
0					
	200				1,144,200

$$(200)^2 = 40{,}000$$

$$\frac{1{,}144{,}200}{40{,}000} = 28.605 \text{ ft.}$$

$$\frac{28.605}{35.9} \times 100 = 79.7\%$$

Mr. Carey showed that the distance to the load center for purpose of voltage drop was 35.9 ft. Above is shown ratio of the distance to the load center for power loss and distance to the load center for voltage loss, with the result that the former is 79.7 per cent of the latter. As previously, if the load is uniformly distributed throughout the distance to the load center for power loss purposes would be one-third the total distance, and for voltage drop purposes one-half of the total distance, giving a ratio of 66.6 per cent.

This opens up several other very interesting points which might with advantage be discussed at greater length at some future time.

ARTIFICIAL COOLING WITH SPRAY EFFECTS ECONOMY.

Artificial Cooling Reduces Central Station Water Bill Over 500 Per Cent Annually.

So much attention has of late been devoted to coal, its scarcity, high cost and conservation, that most of the proposed economies in power houses have dealt with some method of improving or operating apparatus so as to save coal. There are, however, other economies that may be obtained, some of them quite easily, and at small cost. This fact was recently brought out in a central station of about 38,000 kilowatts generating capacity. The economy brought about was due to a reduction of water consumption, however, and not of coal, the water being purchased from the city supply at flat rate.

The station contained a number of reciprocating engines and turbines, some operating on exhaust steam. City water was used for cooling the bearings and lubricating oil, and after passing through the cooling coils was allowed to go to waste into the sewer. In looking for economies it was decided to use the bearing cooling water over and over again instead of allowing it to flow in continuous discharge to the sewer. A tank was already available on the roof. This was gotten into shape and a cooling tower of the spray type with splash boards was erected adjacent to this tank. Supply tank and bearing cooling coils were piped, the piping going back to spray jets on the roof. Between cooling coils in the engine room and spray jets on roof was installed a centrifugal pump. By this arrangement the same water could be used over and over again, except for occasional make-up due to evaporation, spillage and leakage. The pump forced the water to the roof and through the spray jets without creating positive pressure in the bearing cooling coils, since it was installed between cooling coils and the spray. From the spray pan the water traveled by gravity into the storage tank beneath it and thence through the cooling coils below. An arrangement of pipes was used by which the sprays could be short-circuited during the winter when lower ambient temperatures made artificial cooling unnecessary. Moreover, means were available for permitting the water to discharge from cooling coils to sewer, thus enabling the tank storage to be utilized with the pump shut down for short periods, accidental or otherwise, and for direct city supply.

The cost of installing the piping and pump amounted to about $250. On the other hand, the water bill was reduced from $4862 to $882 in one year, with a saving therefore of about $3000. This saving was, of course, well worth while, especially since obtained so simply and inexpensively.

Street Lighting Schedules for April.

Every plant operating street lighting circuits must have a definite schedule for lighting and extinguishing the lamps. Below are given the two most commonly used schedules as compiled for next month. The time is given to the nearest five-minute division of mean solar time and the table is compiled for latitude 40° north. Since throughout April the "daylight saving" plan of having all clocks one hour ahead of normal time will be in effect, the time given in the table must be advanced one hour; thus, for April 18 read 8:10 p. m., 5:50 a. m.; 1:45 a. m., 5:20 a. m.

APRIL, 1918.

Night of April	All-Night Schedule		Moonlight Schedule	
	Light	Extinguish	Light	Extinguish
1.....	6:55	5:15	6:55	12:25
2.....	6:55	5:10	6:55	1:15
3.....	6:55	5:10	6:55	2:05
4.....	6:55	5:10	6:55	2:50
5.....	6:55	5:10	6:55	3:30
6.....	7:00	5:05	7:00	4:05
7.....	7:00	5:05	7:00	4:35
8.....	7:00	5:05	7:00	4:35
9.....	7:00	5:00	7:00	4:30
10.....	7:00	5:00	7:00	4:30
11.....	7:05	5:00	7:05	4:30
12.....	7:05	4:55	7:35	4:25
13.....	7:05	4:55	8:45	4:25
14.....	7:05	4:55	9:50	4:25
15.....	7:10	4:50	10:45	4:20
16.....	7:10	4:50	11:35	4:20
17.....	7:10	4:50	12:10	4:20
18.....	7:10	4:50	12:45	4:20
19.....	7:10	4:45	1:15	4:15
20.....	7:10	4:45	1:40	4:15
21.....	7:15	4:45	2:05	4:15
22.....	7:15	4:40	2:25	4:10
23.....	7:15	4:40	2:50	4:10
24.....	7:15	4:40	No light	
25.....	7:20	4:40	No light	
26.....	7:20	4:35	No light	
27.....	7:20	4:35	7:20	9:20
28.....	7:20	4:35	7:20	10:15
29.....	7:20	4:30	7:20	11:10
30.....	7:25	4:30	7:25	12:05

Tables for each month of the year, rules for the two schedules given above and for modifications of them, corrections for standard time and latitude, monthly and yearly total hours of burning for the five most common schedules, as well as other information pertinent to the subject, are printed in a booklet obtainable from the ELECTRICAL REVIEW for 25 cents a copy.

Contracting-Construction

Section 31 of Part III, National Electrical Safety Code—An Entire Town Quickly Equipped—Among Contractors

PART III OF THE NATIONAL ELECTRICAL SAFETY CODE.

Rules for the Installation and Maintenance of Electrical Utilization Equipment.

[*The* ELECTRICAL REVIEW *has found that electrical contractors are quite unfamiliar with the National Electrical Safety Code, drafted by the Bureau of Standards, Washington, D. C. This new Code aims to minimize the life hazards connected with the use of electricity. Part III of the Code is of special importance to contractors, who will be called on more and more to make their installation work conform to its requirements. To acquaint them with this portion of the Code, Part III is being reproduced in these columns, the first section (Section 30) having appeared in last week's issue. Section 31 with discussion appears below. The remaining sections of Part III will be published in the following issues.*]

SECTION 31.—CONDUCTORS.

310. Electrical Protection.

(*a*) Conductors shall be suitable for the location, use and voltage, and each conductor (except neutral conductors, ground wires and conductors of circuits the opening of which may cause special hazard by the interruption of service or removal of protection) shall be protected against excessive current by a suitable automatic cutout or by the design of the system.

(*b*) Neutral conductors in three-wire systems shall be arranged without automatic cutouts interrupting their continuity, unless the cutout opens all conductors of the circuit with one operation. Switches in three-wire circuits shall either open all conductors of the circuit with one operation or be omitted from the neutral. The neutrals shall everywhere be of sufficient size to safely carry the maximum current in either outer conductor at that point.

In two-wire branches from three-wire circuits the conductor connected to the neutral is not for the purpose of this rule considered a neutral conductor.

(*c*) All conductors normally grounded for the protection of persons shall be arranged without automatic cutouts interrupting their continuity between the source of electrical supply and the point at which the ground wire is attached, unless the cutout opens all conductors of the circuit with one operation. Switches shall either open all conductors of the circuit with one operation or be placed only on ungrounded conductors of the circuit, except that this does not necessarily apply to single-pole key sockets.

Where the utilization equipment is connected to electrical supply lines, the point of connection to the service leads is considered as the source of electrical supply.

The identification of neutral and grounded conductors by some suitable marking will facilitate compliance with the rule.

311. Mechanical and Thermal Protection.

(a) Where exposed to mechanical injury, suitable casing, armor or other means shall be employed to prevent injury or disturbance to conductors, their insulation or supports. Conductors used as meter loops shall be substantially supported clear of objects other than their insulating supports, and separated from each other, or shall be in approved conduit or substantial non-combustible, non-absorptive casings.

(*b*) Where conductors with combustible insulating coverings are closely grouped (as sometimes on the rear of switchboards or in cableways) they shall have a substantial non-combustible outer covering. Conductors in very hot locations shall have a non-combustible insulating covering.

(*c*) Bare conductors shall be used only for switchboard, panelboard, or storage-battery connections; or for electrolytic, low-voltage furnace, or low-voltage welding circuit, and similar connections; or for trolley wires, third rails, and other contact conductors and parts at different potentials. Such bare conductors shall be fixed at adequate separations by the use of suitable supports. Except at the point where a permanent ground connection is made, such conductors within buildings shall be kept insulated from the ground. Bare conductors shall not be used where inflammable gases or explosives are liable to exist in large quantities. (See Rules 306 and 312 for guarding requirements; also see Rule 91 *c*.)

312. Isolating or Guarding.

All fixed conductors having insulating coverings and operating at over 300 volts to ground, and bare conductors at all voltages shall (unless guarded as required in Rule 313) be so isolated by elevation (as required by Rule 306 *a*) that no person can inadvertently come or bring conducting objects in contact with them.

313. Guarding Conductors.

(a) Use of Inclosing Casings.—For inclosing insulated conductors, approved permanently grounded metal conduit, waterproof insulating conduit, or grounded metal sheathing shall be used, except that in dry places, ducts, runways, or compartments of suitable fire-resistive material, may be used for conductors below 750 volts, if containing no exposed combustible material. (See Rule 318 for further exception.) In damp places conduit shall be made waterproof and provided with suitable means for draining off condensation, unless the conductors contained are lead-sheathed cable.

(b) Open Conductors Below 750 Volts.—Where open insulated conductors between 300 volts to ground and 750 volts, or open bare ungrounded conductors at any voltage below 750 volts (except bare wires used at high temperatures in heating devices, at voltages not exceeding 300 volts to ground) are necessarily brought closer to the floor line than 8 feet, they shall be guarded by permanent screens or inclosures.

(c) Where persons at any time remove or pass by screens or other guards for bare conductors while such conductors are alive, such screens or guards shall be of insulating material, and all conducting floors, walls, machine frames, and similar surfaces within 8 feet below the conductors or 3 feet horizontally from

them, shall be covered with suitable insulating platforms, mats, or covers. (See Rule 306 *b.)*

Dependence should not be placed on the unprotected insulating covering as a suitable guard or inclosure for such conductors near the floor line, nor in certain other cases (see Rule 306 *a*). Other guards should be provided to protect the insulation against mechanical injury and to secure the safety of persons who must come near the conductors.

314. Guarding in Damp or Hazardous Locations.

(a) Conductors in damp locations or where exposed to corrosion, if not in waterproofed conduit, or in waterproof metal sheaths in other suitable ducts, shall be effectively isolated and supported on insulators of a suitable type.

(b) Conductors in locations where inflammable gas or flyings normally exist shall be in grounded metal conduit or metal-sheathed cable. All fittings and outlets of such conduit and cable shall be electrically and mechanically continuous with the conduit or metal sheath, and the conduit shall be sealed by the use of suitable potheads or equivalent devices to prevent entrance of gases.

315. Precautions to Avoid Excessive Inductance and Eddy Currents.

Supply conductors of alternating-current or direct-current circuits should not be run in separate iron conduits or on opposite sides of I-beams or other iron structures or be otherwise run so as to increase abnormally the self-inductance of the circuit.

Such construction, by introducing large self-inductance in direct-current circuits, causes fuses to blow explosively; in alternating-current circuits it causes heating due to eddy currents in the metal.

316. Pendants and Portables.

Pendants or portable conductors shall not be installed or used on circuits operating at over 300 volts to ground, unless they are accessible only to persons authorized to approach them. In such cases they shall be of a type suitable for the voltage and conditions, and conform to the rules of Section 37.

317. Taping Ends and Joints.

Ends and joints of insulated conductors, unless otherwise adequately guarded, shall have equal insulating covering with other portions of the conductor, and this covering shall be securely held in place.

318. Grounding or Isolating Service Conduits.

(a) Metal conduit or sheathing incasing service conductors from either overhead or underground lines shall either be (1) permanently grounded as required by Rule 304, or (2) effectively isolated by elevation. (See Rules 304 and 306.)

(b) If not grounded, the service conduit or sheathing shall be effectively insulated from metal work of the building, and from its piping. Where service conduit or sheathing is electrically continuous with interior conduit or sheathing, the grounding required for conduit (by Rule 304 *c*) shall be made direct to the service conduit or sheathing and shall have conductance not less than that of No. 6 copper wire.

(c) Where grounded service conduit or sheathing is insulated from interior conduit or sheathing, its ground-wire conductance need not exceed that required under Section 9, for equipment ground wires.

It is frequently advisable to insulate interior conduit or sheathing from underground service conduit or sheathing, to prevent burnouts of small interior conduit, armored cable sheaths or metal molding, by large currents which might flow from grounded circuits through the interior metal to water pipes or other good ground connections within the building.

319. Temporary Wiring.

Temporary wiring and equipment, which is not in compliance with the rules, may be used, but only when under competent supervision, or protected by suitable barriers or warning signs while it or neighboring wiring is alive and accessible to any person.

DISCUSSION OF SECTION 31.

310. Electrical Protection.

For the best protection of persons in the vicinity of or engaged in operating switches, the conductors of the circuit concerned need automatic protection against currents large enough to exert disruptive stresses, to cause serious arcing or short circuits at switches, to melt connections or the conductors themselves, or even to seriously damage the insulating coverings of the conductors.

Neutral conductors should not be interrupted unless outer conductors are disconnected at the same time, since this might result in an unbalancing of the load and the subjection of equipment and operators to nearly double the designed voltage.

In general, double fuse protection in the final circuits to equipment or devices is necessary to provide sufficient assurance against the explosion or failure of fuses under severe short circuits. See "Investigation on Inclosed Fuses" by the Bureau of Standards (Technical Paper No. 74).

A grounded conductor should never be interrupted by the opening of an automatic cutout between the source of supply and the ground wire, since this would permit the entire circuit to lose its ground connection and possibly to assume the voltage and hazard of any circuit by which it is exposed and from which leakage might therefore occur. (See discussion on Rule 92 *a.**)

313. Guarding Conductors.

Inclosing conductors in suitable inclosures, of insulating material or grounded metal, provides one of the most effective means of guarding persons from contact with them.

314. Guarding in Damp or Hazardous Locations.

Conductors in very damp locations where moisture collects on the wires can not be considered as effectively guarded by their insulating covering, even at very low voltages, since the deterioration of insulation and the danger from even slight leakage is considerable. If such conductors are not in grounded conduit, the only effective protection will be through isolation by elevation beyond reach of persons in the vicinity. In order that the surfaces on which the conductors are supported will not receive sufficient leakage to become dangerous to persons in the vicinity, the open wires in such locations should be supported on insulators having a leakage path of sufficient length to reduce leakage to a minimum. For conductors in locations where inflammable gas exists, see discussion on Rule 154 in Part I giving the rules for stations.

318. Grounding or Isolating Service Conduits.

(a) Service conduits from overhead lines are subject to occasional leakage from the contained conductors, due to breakdowns. While considered safer to persons if grounded, the guarding of exposed service conduits for a distance of at least 8 feet from the ground, or floors accessible to the public, is considered to afford reasonable safety where the protective ground connection is *not* provided. Underground service conduits are easily grounded and frequently contain grounded metal-sheathed cable, thus making unnecessary any other ground.

(b) When conduit containing service conductors on the supply side of service cutouts is not directly and permanently grounded, it should not be allowed to be in contact with metal of interior conduits or with metal parts of the building. This is because the interior conduits or the metal parts of the building, such as metal awning frames or metal sidings, may not be sufficiently well grounded to prevent their being raised to a dangerous potential by contact with an ungrounded or poorly grounded service conduit. Cases have occurred where small ground connections to conduit within the building have been burned or broken off. Therefore, either the very thorough and direct grounding of the service conduit, or its careful insulation from the interior conduit and from the building framework, together with its isolation from persons in the vicinity, are required for safety.

319. Temporary Wiring.

The tendency to install unsubstantial wiring with the purpose of soon correcting the defects is responsible for the existence of much defective wiring in present equipment. Such "temporary" wiring often remains for years, presenting a serious menace to operators and service, whereas the additional cost and time required to make the installation substantial would have been inconsiderable.

*This forms a part of Section 9, an introductory section to the Code proper which contains rules covering methods of protective grounding.

(To be continued.)

COPIES OF THE NATIONAL ELECTRICAL SAFETY CODE.

In the ELECTRICAL REVIEW of March 9, 1918, in an article on "Safe Installation of Electrical Utilization Equipment," appeared the statement that copies of the National Electrical Safety Code could be procured for 40 cents. This was the price of the first thousand printed. We are informed that later copies can now be procured at reduced prices, as follows: Paper-bound copies at 20 cents each; cloth-bound copies at 30 cents each. The order should be sent to the Superintendent of Documents, Government Printing Office, Washington, D. C., accompanied by cash or postal money order. Do not send stamps.

CONSTRUCTING ENTIRE ELECTRICAL SYSTEM FOR A TOWN IN FEW MONTHS.

Electric Construction & Machinery Company Completes Big Contract in Milledgeville.

To the residents of cities of 1000 population or more in these days the use of electricity has become so common as to excite no comment whatever, indeed, its absence is a cause for wonder, and the residents of towns not so served are dissatisfied as long as they are deprived of the use of this very necessary commodity.

The town of Milledgeville in Carroll County, Ill., was so situated and has been wrestling with the problem of securing electric service for the last five years. They did not want makeshift service, and until very recently the utility companies were not ready to spend the money necessary to put over the enterprise.

In June, 1917, a contract aggregating $50,000 was entered into between the citizens of Milledgeville, the Illinois Northern Utilities Company and the Electric Construction & Machinery Company, of Rock Island, Ill., to construct a complete electric service system.

The latter company did all the engineering and built twelve miles of 13,000-volt transmission line from Polo to Milledgeville, also all the local overhead distribution in Milledgeville, including the substation and all the interior wiring, and fixture installation on the premises of the consumers.

After completion, the plant was turned over to the Utilities Company in complete operative condition.

All outside construction was done under the supervision of J. J. Murphy and the interior work was supervised by W. E. Hartman. That the installing is satisfactory, is indicated by the following extract from the Milledgeville local paper:

"Milledgeville now has access to the vast electric energies of the Northern Utilities Company's enormous plants. The wiring on the streets and in the business houses and dwellings is practically completed, and we have been quietly enjoying the new lights for some time.

"The stores have had opportunity to compare the cost of a week of electric light with one of the old system, and have credited themselves with a saving of one-half to three-fourths. Charles Alsip is pumping the city's water at less than a dollar a day, whereas in the olden days (a week ago) the city yielded up around two dollars for the same service, and at the same time painfully ignored the old engine's bombardment. There is now a dreamy atmosphere at the pumping station. The soft swish of the belts, the low hum of the powerful motor and the irresistible drive of the big pump fill the place with a suppressed song of industry. Mr. Alsip confidently predicts that he will shave the cost a little more when the co-ordination of parts shall have attained to a maximum perfection.

"The current is ample and the workmanship on the streets, and also the inside wiring, is superb, the Electric Construction & Machinery Company, of Rock Island, having given us a job second to none in the state, not excepting towns of twice our size, and more.

"This electrifying of our village is a great good fortune and our people have accepted it philosophically, although with a feeling of deep enjoyment. At a single bound we have cleared the centuries of non-electricity and come into contact with the last-minute perfection of the electrical age. Nothing electrical is now impossible to us.

"There are 49 lights on the streets of 80 and 100 candlepower, and they are on all night and every night of the year, automatically coming on and going off at stated times.

"Barring accident, the utility current is on continuously, and we may toast bread or light the basement, etc., any hour of the twenty-four.

"There are 76 residences, 24 business houses and offices, 1 elevator, 2 churches, a pop factory, feed mill, feed shed and hotel, making 104 buildings, about all now using electricity. Contracts for 6 more houses and the cheese factory have been secured."

AMONG THE CONTRACTORS.

H. E. Kammann, electrical contractor, Kankakee, Ill., is entering the farm-lighting field, to sell and install storage-battery lighting units.

The G. F. Simmen Electric Shop, La Salle, Ill., recently completed the wiring of the Isolation Hospital, at Peru, Ill., for lighting, signals, bells and telephones. The job amounted to about $2000.

The contract for installing a lighting system in Harlem, Mont., involving the expenditure of $4,500, has been awarded to the Electric Construction Company, St. Paul, Minn., by the City Council of Harlem.

The Baer Electric Company, Van Wert, Ohio, has removed its store and office from 692 to 314 Park place. A good stock of "everything electrical" has been put in at the new quarters and a well equipped shop for the contracting department has been provided.

Charles E. Knox, 101 Park avenue, New York City, has been awarded the contract for electrical work in the new six-story brick and steel factory building of the National Lead Company, of 111 Broadway, New York, which is to be located at Marshall and Gold streets, Brooklyn.

John G. Livingston, Jr., 70 East Forty-fifth street, New York, N. Y., has been awarded the contract for electrical work in connection with the new manufacturing plant being erected at Tyrone, Pa., by the West Virginia Pulp & Paper Company. The plant comprises eight manufacturing buildings, and is estimated to cost $500,000.

The electrical contracting firm of Tucker & Laxton, Inc., Charlotte, N. C., has commenced work on the enlargement of the Omussee plant of the Columbia Power Company, Columbia, Ala., to cost about $500,000. A plant will also be established by the Power Company at Kelso, involving the expenditure of another $500,000.

BOOK REVIEWS

"Everyman's Chemistry," The Chemist's Point of View and His Recent Work Told for the Layman. By Ellwood Hendrick. Harper's Modern Science Series. New York: Harper & Brothers. Cloth, 374 pages (8x6 inches). Supplied by Electrical Review Publishing Company, Inc., for $2.00.

This book is one of Harper's Modern Science Series, and, as its name implies, is an attempt to cover the vast science passing under the name of chemistry in a way that the layman can understand. Obviously a book of 374 pages cannot more than barely touch upon some phase of chemistry here and there, but nevertheless the author has taken up many matters in interesting fashion. The first five chapters, which comprise the first part of the book, are devoted to generalities and introduction. The second section, of thirteen chapters, deals with inorganic chemistry—iron and steel, lime and magnesia, carbon, sulphur and sulphuric acid, sand and clay, air and water, and many more. The third and last part of the book, comprising eight chapters, embraces inorganic chemistry. Two appendices are included, the first dealing with the elements, the second giving a bibliography. Finally comes the index.

The appearance of this book is timely, for no branch of science, surely, has done more than that of chemistry in making possible such a war as is being waged today. Chemistry is, perhaps, one branch of science to which the masses are very largely excluded from its very nature. Economics, hygiene, medicine and engineering are frequently dealt with in the press, but chemistry is left alone. This should not be so, for chemistry enters into every phase of our existence, and from knowledge comes understanding, and from understanding comes greater economy, greater safety, greater health, and so on. Everyman's Chemistry, as its name implies, aims to tell the layman some of the fascinating things of which the average layman knows practically nothing to his loss. The author handles very cleverly a fascinating subject, and one, moreover, that is, at best, difficult to handle.

"Electrical Machinery." By Terrell Croft. New York: McGraw-Hill Book Company. Cloth, 326 pages (8x5½ inches), 302 illustrations. Supplied by Electrical Review Publishing Company, Inc., for $2.00.

Of the writers who contribute freely to a considerable range of technical journals, I doubt if any one has done more towards improving and standardizing electrical practice than Terrell Croft. This new volume not only sustains his reputation for clearness of style and logical arrangement, as well as thorough familiarity with high-class practice, but also appears to be based on a discovery for which the author deserves due credit. It is this, that for every man interested in the theory of the designing and operating of electrical machinery hundreds of other men may be interested in its practical installation and operation. For this larger class of readers, such admirable volumes as, for example, Hobart's "Electric Motors," are quite inadequate, as they are directed to the designer and the student rather than to the men who buy, install and operate electrical machinery.

Realizing this, Mr. Croft has addressed this book with its 300 illustrations to the larger class of readers, and has used non-mathematical language both in explaining the theoretical principles and in outlining the operating facts. But his chapters on the principles, construction and characteristics of the common classes of generators and motors (direct-current motors and generators, alternating-current generators, induction and repulsion motors, and synchronous motors) comprise less than half of the book. The rest treats in orderly manner with the installation, management and testing of the various classes of machinery, with the starting and controlling devices for the same, and with generator and motor troubles.

By copying many paragraphs, and in some instances whole series of pages, from the instruction books of prominent manufacturers and from the works of other authors (for all of which he gives due credit), Mr. Croft has reported modern practice all the more adequately. In some few instances, the explanations sought by the average reader may be missed, as where the author merely refers to the makers' literature for informtion as to the principles on which synchroscopes operate. However, these cases are rare, and access to the voluminous contents of the volume are expedited both by its logical arrangement and by its unusually complete index.

ALBERT SCHEIBLE.

"Radio Communication: Theory and Methods." By John Mills. New York: McGraw-Hill Book Company. Cloth, 205 pages (4¾ by 7⅛ inches). Supplied by the Electrical Review Publishing Company, Inc., for $1.75.

In this volume the author has gathered the substance of a course of lectures given during summer of 1917 to a company of the U. S. Reserve Signal Corps, recruited from men remaining on the payroll of the Western Electric Company while being trained for this signal service. Being intended to supplement laboratory work, these lectures did not deal with either the details of wireless apparatus or the manipulation of the same, but were confined largely to explaining the fundamental principles and methods involved in radio communication and the needed calculations. However, they assumed only the knowledge of elementary algebra and trigonometry, and a limited familiarity with physics, and represent an earnest effort at keeping the needed calculations in simple terms.

Both the method of treatment and the scope of the volume is thus quite different from that in the recently reviewed work of Bucher, and for those not situated where they have access to regular training courses, the two books might supplement each other. An introductory note for non-mathematical readers dispels the readers' fear at the outset, and the wording in general indicates that the author is not only thoroughly conversant with his subject, but a real teacher as well. General chapters on alternating currents, telephone receivers and the vacuum tube open the volume, followed by a short chapter on the detection of high-frequency currents which would be more complete if such earlier devices as coherers had been included in it. However, the author evidently preferred to reserve the space for his more extensive chapters on the production of damped sinusoidal currents and that of undamped high-frequency currents. These are followed by many pages on radiotelegraphy and telephony, and 35 more on practical appliances and methods. Transmission over wire circuits is discussed in an appendix which also contains a long series of exercises for drill in the mathematics of the volume.

ALBERT SCHEIBLE.

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"LET THE CODE DECIDE."

CONDUIT SIZE FOR COMBINATION OF WIRES.

Question 355.—What sized conduit do you advise (when asked for information) for three No. 8, two No. 6, and three No. 12 wires?

Answer 1 (T).—We have not given much thought in regard to this question but in case this comes to our attention we would follow the suggestions as outlined in the issue of the ELECTRICAL REVIEW of March 18, 1916, by Washington Devereux on "How to Find Conduit for Combination of Wire Sizes" as to meet the Code requirements.

Answer 2 (K).—We would require at least 1½-inch conduit.

Answer 3 (O).—It is customary in this jurisdiction, in unusual combinations of several sizes of wire, to estimate the conduit size by reducing the larger wires to their equivalent in No. 14 wire as given in the tables under Rule 28. In the combination included in this question, we have three No. 8's which require a 1-inch pipe; and this will take ten No. 14's; the two No. 6's require, according to the table, a 1-inch pipe, and, therefore, we consider these as also equivalent to ten No. 14's. The three No. 12 wires will require ¾-inch pipe, which is also approved with five No. 14's. The total of these No. 14 wires is 25, which, according to the table on page 68 of the Code, will be comfortably accommodated in a conduit of 1½-inch size.

Answer 4 (V).—I would approve of 1½-inch or larger, depending on the length of the conduit and number of bends.

Answer 5 (H).*—The table given in Rule 28*i* calls for 1-inch conduit for three No. 8, or two No. 6, and ¾-inch conduit for three No. 12.

Answer 6 (P).*—The answer depends upon the layout of the conduit.

Answer 7 (S).*—Would not advise on this combination until I knew the circumstances; do not approve of it.

The matter appearing in this section consists of questions on the National Electrical Code, its interpretation and meaning, and questions as to whether certain methods of wiring are in accord therewith. These questions are gladly received from anyone interested, even if not a member; they should be sent to the secretary with any needed elucidating sketch. They are answered by each member of the Executive Committee, according to his knowledge of what the ruling would be in his jurisdiction.

It should be understood that no pretense is made to give an authoritative interpretation of the Code. This is a voluntary association; it has representation on the Electrical Committee of the National Fire Protection Association, which prepares the Code, but it has no right, and claims no right, to give a final interpretation of anything in the Code. It is only intended to give the interpretation which seems correct to the members of the Executive Committee. No attempt is made to edit or correlate the answers from the different members of the Committee, as it is felt that the occasional difference of opinion is calculated to lead to a further study of the matter in question, further discussion and the final clearing up of obscure points.

The aim is to help toward a better understanding of the Code on the part of all; a more uniform conception of its meaning; increased precision in applying it; and harmonious action of those using it, for the common good.

Answer 8 (B).*—We presume that this question refers to the installation of three No. 8, two No. 6 and three No. 12 wires all in the same conduit. Would say that if our understanding is correct, we would give no advice as to what size conduit, but would inform the party that such construction was not approved in our territory.

Answer 9 (F and G).—We would accept approved conduit 1½ inches in diameter for three No. 8's, two No. 6's, and three No. 12's.

Answer 10 (R).*—1-inch; 1-inch; ¾-inch.

Answer 11 (E).—If the run of conduit were reasonably straight and not very long, 1½-inch pipe might be used. If, however, the run were long and had a few bends, we should recommend the use of 2-inch conduit.

Answer 12 (N).*—The answer to this depends so largely on the arrangement of the conduit that no general statement can be made. Probably in the majority of cases 1½-inch conduit would be sufficient in each of these combinations.

METHOD FOR FINDING SIZE OF CONDUIT FOR COMBINATIONS OF WIRE SIZES.

Question 356.—What is a good method to suggest for determining the proper size of conduit for various combinations of circuits of different size wires not identical with combinations given in the tables found in the Code?

Answer 1 (H).*—Add the outside diameter of the different combinations called for and compare with the inside diameter of the conduit in question, care being taken to allow sufficient space for pulling around bends.

Answer 2 (K).—The City of Portland, Ore., has a table worked out which we have found very satisfactory. For example, Rule 28 of the Code requires at least 1-inch conduit for three No. 8 wires or two No. 6 wires and at least ¾-inch conduit for three No. 12 wires. The area of 1-inch conduit equals 0.785

square inch and that of ¾-inch conduit 0.442 square inch. Therefore, 0.785 + 0.785 + 0.442 = 2.012. The area of 1½-inch conduit equals 1.767 square inches and that of 2-inch conduit equals 3.141 square inches. Practical judgment can be exercised to allow a 1½-inch conduit inasmuch as we know there is space to spare in all of the individual conduits as called for in the Code.

Answer 3 (*O*).—The answer to this question is given under No. 355.

Answer 4 (*P**).—With a pair of compasses draw a circle with a diameter equal to the diameter of the conduit. Within this circle plot circles representing the external diameters of the various wires. Note the clearances. Consider the layout of the conduit. Use your judgment.

Answer 5 (*S**).—Best method is not to allow any more of a combination than possible.

Answer 6 (*B**).—No method to suggest.

Answer 7 (*F and G*).—In order to readily determine the proper size conduit to be used for a combination of wire sizes, the table below may be used to advantage, as follows:

For example: What size conduit is required for four No. 8 and three No. 10 slow-burning wires? According to the National Electrical Code, four No. 8 wires require 1-inch conduit, three No. 10 wires require ¾-inch conduit. The equivalent area of 1-inch conduit is 1; the equivalent area of ¾-inch conduit is 0.5; adding these areas we have 1.5. The nearest size conduit corresponding to area of 1.5 is 1¼-inch conduit, in accordance with the following table:

Conduit sizes.	Equivalent area.
¼	0.25
½	0.50
1	1.
1¼	1.5
1½	2.25
2	4.
2½	6.25
3	9.

Answer 8 (*R*).—The "equivalent-area method" as suggested by Washington Devereux* is the only solution we have had to this problem up to the present time, although in some cases this method calls for a larger pipe than practice seems to warrant.

Answer 9 (*E*).—We are not familiar with any "cut and dried" method of determining the size of conduit to be used, other than to measure the cross-section of the conductors and the conduit.

Answer 10 (*T*).—We have no particular method to suggest.

Answer 11 (*V*).—We have no general method to apply.

Answer 12 (*N**).—The only method that I can suggest is to take the equivalent areas of the proposed conductors in the combination, and then find from a curve plotted showing the areas and corresponding conduit sizes drawn from the National Electrical Code data, where the special combination in question fits in. Then if there is a considerable departure from usual layouts, something must be allowed for possible added stiffness of the combination.

Wiring of Greenhouses.

Question 357.—What has been your practice in connection with the wiring of greenhouses, and what failures have you found it particularly necessary to guard against?

Answer 1 (*T*).—In connection with wiring for greenhouses it has been our practice to follow the requirements of the Code for wiring in damp places, as in this class of risk there is always more or less moisture.

Answer 2 (*K*).—In the wiring of greenhouses our local requirements would call for a weatherproof conduit installation. Condensation is particularly necessary to guard against.

Answer 3 (*O*).—We have had no particular trouble in this jurisdiction with wiring in greenhouses and recommend no special precautions.

Answer 4 (*V*).—We have had very little experience, but have used Sherarduct or Galvaduct and had no trouble.

Answer 5 (*H**).—We have insisted upon conduit work in greenhouses, the pipe being so arranged as to drain off the results of any possible condensation. Open work is hard to protect from mechanical injury and, for that reason, conduit is preferred.

Answer 6 (*P**).—I have had no special experience in greenhouse wiring nor have any unusual failures in this kind of installation been reported. We class greenhouses merely as "damp places."

Answer 7 (*S**).—Greenhouses are wired in iron with porcelain sockets by ordinance. Never had any serious trouble.

Answer 8 (*B**).—We have had but very little experience in the wiring of greenhouses. Such cases as we have had have been wired with insulator and weatherproof construction. We have had no trouble with same.

Answer 9 (*F and G*).—In connection with the wiring of greenhouses, we find open wiring to be the best. In order to avoid trouble from condensation, all wiring and fittings should be of weatherproof type. Porcelain knobs should be fastened by means of brass screws and both knobs and screws coated with a good insulating varnish. Lamps should be switch-controlled. Switches and cutouts should be inclosed in iron boxes well coated, with the switches operative from the outside of box, and all openings in box to be sealed to avoid circulation of air and consequent condensation.

Answer 10 (*R**).—Have had no experience with this type of work in this section.

Answer 11 (*E*).—Breaking down of sockets through moisture is the chief trouble. We are urging the use of weatherproof sockets suspended from No. 14 rubber-insulated wire, rather than flexible cord for installations in greenhouses, owing to the dampness which is noticeable in the upper part of the house.

Answer 12 (*N**).—We must guard against all the failures incident to the presence of excessive moisture, and in addition occasionally to the presence of organic matters dissolved in the suspended water, arising from the fertilizers used, sometimes insecticides, etc. I prefer a tight conduit system with galvanized pipe, damp-proof outlets and weatherproof sockets and leads outside the conduit.

Next to that a carefully installed system on porcelain knobs and weatherproof sockets with No. 14 wire leads; no key sockets nor attachment plugs, but the circuits subdivided and controlled from the headhouse.

*See Electrical Review and Western Electrician, March 18, 1916, page 515.

ELECTRICITY REPLACES PLUMBERS.

Seventy-five frozen water services were thawed out by electricity during February by the Danbury & Bethel (Conn.) Gas & Electric Light Company. This total included two schoolhouses and one factory. The company had ten other calls for similar service that could not be handled as they were either on cement water mains or located off its lines.

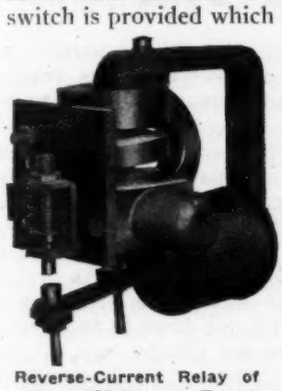
New Appliances

Reverse-Current Relay—Electric Heating Pad—House Pump —Lightning Arrester—Farm Plant—Cut-Finishing Machine

REVERSE-CURRENT RELAYS.

A new form of reverse-current relay has been developed by the Automatic Reclosing Circuit Breaker Company, Columbus, Ohio. These relays are of the circuit-opening type and are so designed that the relay will open either upon reversal of current or with zero current at abnormally low voltage.

The relay is closed and held closed by a shunt polarizing coil. A high resistance is connected in series with this coil. To close the relay a push-button switch is provided which temporarily short circuits the high resistance. The high resistance limits the current in the shunt winding to just sufficient value to hold the relay closed. A reversal of current or failure of voltage will thus cause the relay to open.



Reverse-Current Relay of 400 to 800-Ampere Type.

Reverse-Current Relay of 1200 to 2000-Ampere Type.

These relays are designed for mounting on the rear of the circuit-breaker panel. The 1200 and 2000-ampere sizes have a magnetic yoke which surrounds the upper stud of breaker. The 400 to 800-ampere size relays are provided with a series winding, the terminal of which is connected directly to the upper stud on the rear of panel.

"UNIVERSAL" ELECTRIC HEATING PAD.

The "Universal" heating pad manufactured by Landers, Frary & Clark, New Britain, Conn., has a number of unique features. Chief among these is the spirally wound heating wire, permitting flexibility without danger of breaking. Temperature control is by permanently calibrated thermostats, selected by a simple one-piece lever switch. Guesswork and the hazard of overheating are thus eliminated.

Heating Pad Made by Landers, Frary & Clark.

Another important feature is the positions of the four thermostats. No matter how the pad is folded, no large fold can be made which does not include a thermostat. Hot spots and possible resultant fires are done away with.

The cover is gray eiderdown and a washable slip is furnished; 10-foot cord is supplied with switch placed a convenient distance from the pad.

NEW ELECTRICALLY OPERATED HOUSE PUMP.

A new small-capacity electrically driven pump has been developed by the Crestline Manufacturing Company, Crestline, Ohio, which is especially suited to replace the common water lift to pump rain water for soft water in residences. It can also be used for general water supply in homes when city water supply service is not available and the pump can be placed so the suction lift will not be over 25 feet.

The outfit is made in two capacities—Model A, the single-cylinder type with a capacity of 125 gallons per hour, and Model B, with a capacity of 250 gallons per hour. Both will operate against 50-pound pressure.

Crestline Motor-Driven House Pump.

An automatic controller switch is connected with the discharge and is set to operate between pressures of 40 pounds maximum and 20 pounds minimum. It can be adjusted, however, to operate at practically any desired pressure.

The pump gears run in oil and this same oil is automatically carried to all the pump bearings. The only oiling necessary, therefore, is to place one quart of oil in the oil chamber on starting. This will be sufficient for one year's normal service.

The cylinders are brass-lined, have a 1.5-inch bore, 3-inch stroke, and are self-primed. An air valve pro-

vides sufficient air for the pneumatic pressure tank system. The valves are bronze and rest in bronze seats.

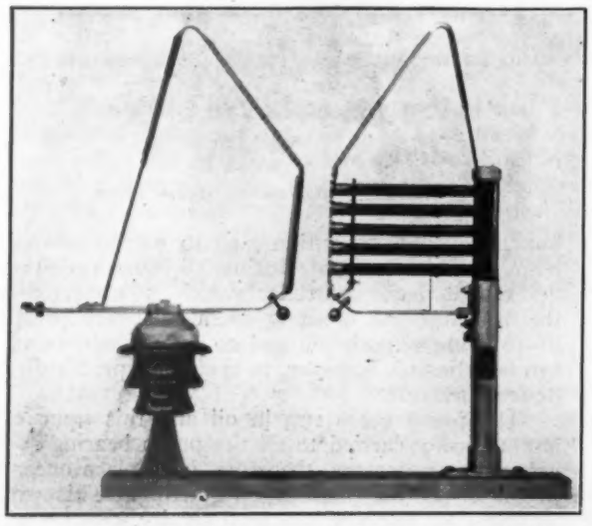
The pump and motor are mounted on a cast-iron base. The pump is a slow-speed type which is connected to the motor by belt with idler-pulley attachment. Model A is fitted with a 1/6-horsepower Robbins & Myers motor and Model B with a ¼-horsepower motor of similar make.

HIGH-SPEED SPHERE-GAP GRADED-RESISTANCE LIGHTNING ARRESTERS.

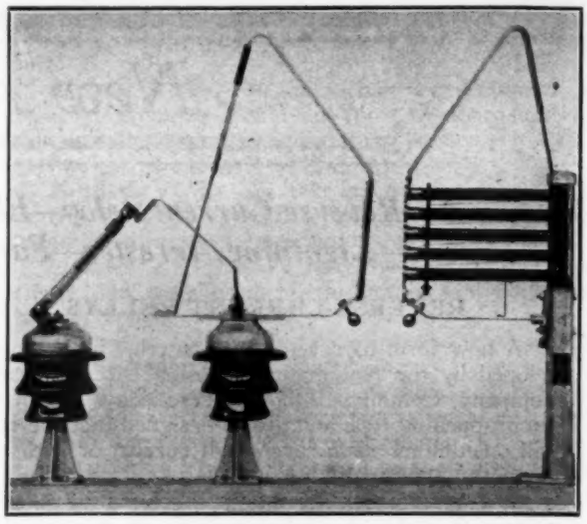
If a lightning arrester is to be effective in protecting electrical apparatus, it must offer instantaneous relief from abnormal voltages. But in order to avoid system disturbances, as a result of its operation, it must prevent the flow of excessive dynamic or generating current after the abnormal potential has been dissipated. The high-speed sphere-gap graded-resistance lightning arrester manufactured by Schweitzer & Conrad, Inc., Chicago, Ill., has these desirable features. An additional important feature, at these times of extraordinary high prices, is its moderate cost.

S & C high-speed sphere-gap arresters, although they have been in extensive service for over three years, have gradually been improved until the present highly effective design was developed. The novel features of this arrester are quite apparent from the illustrations. The gap is smallest at the upper end of the converging portion of the horns, where the maximum resistance is in circuit. At the lowest or "no-resistance" step the gap is considerably larger. It becomes smaller gradually, until the highest resistance step is reached, and from there on the horns diverge upward.

This arrangement has several important advantages. With any potential rise on a system protected by the arrester, the arc will start across the smallest gap with all of the resistance in series. If the potential rise is of low-energy capacity, the current flowing through this gap and comparatively high resistance may be sufficient to keep the voltage down to approximately normal. If the current flowing through this gap of maximum resistance is not sufficient to keep the voltage down, the arc will break across the next lower step and a larger current will flow. If this current is still insufficient to keep the voltage at a safe



Form-1 S & C High-Speed Sphere-Gap Graded-Resistance Lightning Arrester for 22,000 Volts.



Form-3 S & C Graded-Resistance Arrester for 22,000 Volts, Including Series S & C Fuse.

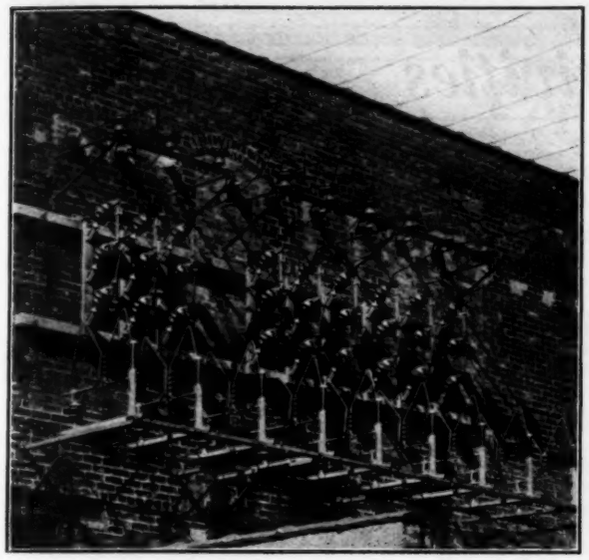
value, then the next lower step will arc across, etc., until the "no-resistance" or lowest step is reached, when a practically unlimited current is allowed to flow to ground.

When the particular step is reached where sufficient current will flow to dissipate the potential rise, the voltage will be reduced to its normal value, and the arc will then tend to rise along the converging part of the horn, being driven upward by both the heated air and by the electromagnetic effect. As the arc rises along the converging part of the horn, the dynamic or generator current is cut down in value as the resistance in circuit is increased step by step, until the diverging portions of the horns are reached, where it will rise and lengthen until the arc breaks.

With the smaller gap at the upper or high-resistance step, the arc tends to rise rapidly and freely over the resistance steps of the arrester. The graded-resistance effect is very desirable, as it is a great deal better to limit the discharge with resistance and avoid short-circuiting the system if the potential rise can be dissipated without such short-circuiting. On the other hand, an arrester which always has a fixed amount of resistance in series will not allow sufficient current to flow during the most dangerous potential rises, and is, therefore, not entirely effective as a protective device.

This action can appropriately be compared with a steam boiler which has a number of safety valves, each with a different opening and each set to operate at a different pressure. The valve with the smallest opening would be set at the lowest pressure and that with the largest opening would be set at the highest pressure. With this arrangement a boiler carrying a normal pressure of, say, 200 pounds, might have a 1-inch pop valve set at 225 pounds, a 5-inch pop valve set at 250 pounds and a 10-inch pop valve set at 300 pounds. If excess pressure could be dissipated by means of the 1-inch valve set at 200 pounds, it would be much more desirable than dissipating the excess pressure by means of a 10-inch valve set at 300 pounds, because the operation of the large valve would very probably lower the pressure in the boiler to such an extent that apparatus connected to it would be seriously affected.

The construction of the S & C arrester is very rugged and durable. The resistance units are inclosed in the highest grade of Bakelite tubes, which protect



Installation of Nine 13,200-Volt Form-1 S & C Arresters with Series S & C Fuses on Separate Mounting.

them effectively against the weather, so that the arrester can be used outdoors without any protection whatever against the elements. The gap is adjustable. The "live" horn is designed so that it can be moved freely by simply loosening two bolts of a clamp on top of the porcelain insulator cap. The return brace of the live horn is sectionalized by means of Bakelite strips, so that the current can only flow in the proper direction, in order to obtain the maximum magnetic effect tending to drive the arc upward along the graded-resistance steps. The insulators used are of the most modern type and are rated at voltages very much in excess of the rated voltages of the arresters.

The illustrations herewith show 22,000-volt form-1 and form-3 arresters. The latter arrester is equipped with a series fuse which will operate in case of extremely heavy discharges across the lowest or no-resistance steps. This arrangement, or a modification thereof, is recommended for electrical systems with large connected generator capacity.

In the installation illustrated, the regular form-1 arrester is used, with series S & C fuses on a separate mounting. This particular installation, it will be noted, consists of nine 13,200-volt arresters, and illustrates how simple and inexpensive the required supporting structure is.

MAYHEW FARM-LIGHTING PLANTS.

The Mayhew Company, Milwaukee, Wis., has developed and placed on the market an efficient and economical farm-lighting plant in three sizes. No. 2 Mayhew Electric is a 50-light unit, consisting of a 20-ampere dynamo and 60-ampere-hour battery; No. 3 is a 60-light plant, with 20-ampere dynamo and 90-ampere-hour battery; No. 4, of 100-lights, has a 20-ampere dynamo, with 120-ampere-hour battery. The plant consists of generator and switchboard in one unit, and a storage battery of 16 cells. It is the belted type, designed to be driven by a gasoline or oil engine that may be required for pumping or other uses on the farm premises. The idea is to obviate the necessity of buying a separate engine for operating the lighting plant which would be idle when not needed to drive the generator.

This is a 32-volt system, giving a combination that has been found most suitable for such rural plants, and the 16 battery cells give sufficient voltage for securing brilliant lights. The plant is made up of a generator of Peerless Electric Generator Company, Akron, O., a switchboard equipped with Jewell instruments and Cutler-Hammer rheostat, and batteries of the Globe Electric Company, Milwaukee. The generator has a capacity of 800 watts.

As illustrating the service rendered by this system, the storage battery of the 50-light plant, after being fully charged, will supply current for lamps as follows: 12 20-watt lamps, 8 hours; 15 20-watt lamps, 5 hours; 25 20-watt lamps, 3 hours. The dynamo of this unit has a capacity to supply 18 20-watt lamps continuously.

The utility and economy of the farm-lighting plant has been thoroughly demonstrated and the demand for it among prosperous farmers is a positive one.

A MOTOR-OPERATED MACHINE TO FINISH CUTS.

The J. A. Richards Company, Kalamazoo, Mich., has developed a motor-operated machine for standardizing print shop and composing room operations. The same machine buzz saws, jig saws, drills, touts, broaches, notches, undercuts and mortises any electros, halftones, etchings and bases, also "boiler plate" and linotype slugs.

A swinging jig-saw arm is provided, permitting this part to be swung at right angles with the circular saw to permit material of any length being run through the machine.

As shown in the illustration, devices on the table of the machine are belt-driven from a fractional-horsepower motor made by the General Electric Company. Current is obtained from the lamp socket and a proper motor is furnished to operate on the current available in the print shop.

Electric Machine for Finishing Engravings, Etc.

Trade Activities

Vanderbeck, Hodson & Ryan Organized—Federal Sign Sustains Heavy Fire Loss—Valuable Catalogs Distributed

Majestic Electric Development Company, San Francisco, Cal., is sending out circular matter describing its various electric heaters. The Majestic instantaneous water heater shown is a compact and efficient device for attachment to any lamp socket.

The Permutit Company, manufacturer of water softening and water rectification apparatus, and for several years past located at 30 East 42nd street, New York City, announces its removal to 440 Fourth avenue, where the entire top floor will be occupied by its offices.

General Electric Company, with general offices at Schenectady, N. Y., proposes to erect 400 to 500 modern dwellings near its plant at Erie, Pa., and will comprise the largest of the General Electric group. The number of employes has increased to such an extent that it is necessary to erect hundreds of buildings to house them.

Vanderbeck, Hodson & Ryan, Inc., with offices located in the Finance Building, Philadelphia, Pa., is a recently organized firm which will engage in electro-metallurgical work, covering the whole field of electric furnaces. The president of the new concern is Frank Hodson, and with him are associated S. R. Vanderbeck, vice-president, and F. J. Ryan, secretary and treasurer. Mr. Ryan will also act as manager of the firm.

H. Boker & Company, Inc., with main offices at 101 Duane street, New York City, and branch offices in Boston, Philadelphia, Chicago and Cleveland, is sending out a circular describing its complete line of Marelli fans. These fans are claimed to give high efficiency and are remarkable for their noiseless running qualities. They are furnished for both alternating and direct current motors. The circular is well illustrated and contains complete data as to the styles of Marelli fans offered, size of blade, prices, etc.

Henderson Electric Company, Ampere, N. J., recently issued a leaflet dealing with the Henderson portable conduit bench. This bench consists of a compact pipe vise and bending stand, which meets the requirements of electricians and other mechanics who cut, thread and bend pipe. Although light in weight, it is strong enough for continuous and efficient service in working ¾-inch and smaller pipe and conduit. Every outfit is supplied with a Henderson conduit bender, rigidly mounted opposite the vise and is designed to bend pipe largely by the weight of the workman as the pipe is fed into the bender. A circular containing a brief description of the Henderson patent boring machine for boring joists for electric light wiring has also been distributed by the company. This machine is simple in construction, reliable and durable, and is now used by thousands of the most progressive central stations and wiring contractors, according to the company.

Terry Steam Turbine Company, Hartford, Conn., is distributing a booklet descriptive of the non-condensing type of Terry turbine which deals at some length with the many advantages of this turbine over reciprocating engines. The main features which have contributed to the successful use of this turbine are its maintained alinement, adaptability, method of lubrication, low cost of upkeep, simplicity and reliability, as well as other salient points to be considered in selecting a suitable turbine drive. The aim of the Terry company has been toward perfecting the design of its turbine, directing particular attention to high operating efficiency, long life and low upkeep cost, and conclusive evidence of the wisdom of this policy is perhaps shown by the extensive use of the Terry turbine in large central stations and in ships of the U. S. Navy where the most efficient and reliable apparatus is selected. Information regarding geared and belted sets, duplex exciters, turbo-generators, etc., is contained in the booklet and illustrations of representative installations and applications are shown.

Parsons Turbines in Japan.—Parsons steam turbines of American build are now, for the first time, in operation in Japan, as a result of sales of one 3200-kilowatt and one 1250-kilowatt machine made by the American Trading Company of New York and Tokio. These were built at the West Allis works of the Allis-Chalmers Manufacturing Company, Milwaukee, Wis.

Simplex Electric Heating Company, 85 Sidney street, Cambridge, Mass., is distributing a bound set of 23 bulletins with a revised price list and index. These bulletins describe and illustrate the complete line of Simplex standard products, including electric household and hotel devices, water heaters, immersion coils, soldering irons, etc., and supersede all previous catalogs.

Horace M. McCord & Company, Inc., Minneapolis, Minn., is distributing an illustrated circular on the Union carboy inclinator. The inclinator is substantially built, holds any size of carboy and returns to an upright position if accidentally released. This product is a labor-saving device and is employed in thousands of industrial plants in the United States and Canada where maximum efficiency is required.

The Pioneer Corporation, Chicago, Ill., is distributing a circular describing its Eradium luminus bulb, which may be attached to any electric or gas light pull chain or key. It is ornamental as well as useful and is guaranteed to be plainly seen all night if left hanging during the day where it can get light. A certificate of endorsement for this device has been received by the company from the household department of Today's Housewife magazine.

Federal Sign System (Electric), Chicago, Ill., suffered a heavy loss when fire attacked its factory located at Lake and Des Plaines streets on March 13. The outbreak of the fire was quickly discovered and the damage restricted to only a comparatively small portion of the plant. The loss, due to damage by water as well as fire, is estimated at about $300,000, covered by insurance. Filling of orders is set back about one week. Rebuilding of the damaged structure is already under way.

Duquesne Light Company, Pittsburgh, Pa., has undertaken the establishment of a series of service stations in Pittsburgh to supply power for electric trucks. As the first unit of its series the company has leased a four-story, reinforced concrete garage, covering 75x131 feet of ground, and is one of the most modern garages in the city. The Duquesne Light Company will take immediate possession of the building and install equipment for the storage, repair and charging of electric trucks.

Westinghouse Electric & Manufacturing Company, East Pittsburgh, Pa., is distributing a six-page booklet which should prove of especial interest to those connected with the heating of baking, drying and japanning ovens. It includes an article "Electrically Heated Japanning Ovens," by C. F. Hirshfield, reprinted from the National Electric Light Association Bulletin, and "Heat Calculation for Baking and Drying Ovens," by W. S. Scott, reprinted from the Electric Journal. Thus there are grouped under a single cover an article giving general considerations in favor of electrical heating for this purpose and an article giving the detailed method of calculation for the amount of heat required to raise the temperature of the work, of the supporting and carrying parts, such as trucks, and of the ventilating air. Methods for computing the losses from the external surface of the oven, and the heat required to raise the temperature of the oven walls, etc., are also given. This publication should be of much value to central station solicitors who are endeavoring to interest their customers in the electrical heating of ovens, as well as to present and prospective users of such equipment. Copies of this publication (Reprint 66) will be furnished on application to any Westinghouse Electric branch office.

Personal

H. W. Alexander Resigns—B. W. Cowperthwait President Minnesota Association—F.B.Duncan Joins Packard Electric

JAMES BRAKES, JR., has resigned his position as power plant inspector for the Western Electric Company to accept a position with the Gamm-Bernstein Motor Truck Company, Lima, Ohio.

STEPHEN A. STEEGE, electrical engineer for the firm of Steege & Dewey, has announced the dissolution of the company. Mr. Steege will continue in business with offices in the Light & Power building, Watertown, N. Y.

H. H. LYONS, superintendent of the Ordway (Colo.) division of the Arkansas Valley Railway, Light & Power Company, Pueblo, Colo., has been appointed local organizer for the sale of Thrift and War Stamps.

R. T. ROSSI, superintendent of the electrical division of the Public Service Corporation, Trenton, N. J., was one of the principal speakers at a meeting of the Trenton Electrical Club on March 4.

JAMES HARMON has been appointed safety manager for the Kentucky Utilities Company, the Interstate Public Service Company and other adjacent Middle West Utilities Company properties with offices in the Paul Jones building, Louisville, Ky.

EARL E. EBY, who for the last two years has been manager of the industrial division of the Pittsburgh office of the Hyatt Roller Bearing Company, Newark, N. J., has been appointed assistant sales manager with offices in the Metropolitan Tower, New York, N. Y.

S. E. DOANE, chief engineer of the National Lamp Works of the General Electric Company, Nela Park, Cleveland, Ohio, presented a splendid paper on "The Aesthetics of Street Lighting" before a meeting of the Philadelphia Section of the Illuminating Engineering Society which took place March 15.

B. H. ELLIS was elected first vice-president of the Manhattan Electrical Supply Company, Chicago, at its annual meeting held recently. Other officers elected were James Ryan, second vice-president, N. F. Johnson, third vice-president and assistant treasurer, and Edgar Whitmore, secretary.

GEORGE CUSTER, of the Union Traction Company, Anderson, Ind., has been appointed engineer of maintenance of way for the Interstate Public Service Company and will begin his duties in the Columbus, Ind., office March 16, devoting his time largely to the work between Columbus and Indianapolis. He takes the place made vacant by the resignation of E. S. Anderson.

F. C. MARQUA has resigned as manager of the Southwest Bell Telephone Company, Kansas City, Mo., to become manager of the new business department of the Southwest National Bank of Commerce of that city. Mr. Marqua is also active in civic affairs, being vice-chairman of the young men's department of the Kansas City Chamber of Commerce.

HARRY W. ALEXANDER, director of publicity, the Society for Electrical Development, New York, has resigned to become assistant to president on sales, American Writing Paper Company, New York and Holyoke, Mass. There are no vice-presidents provided for in the new reorganization. This is the largest manufacturer of high-grade paper in the world. Mr. Alexander, one of the best known men in the electrical industry, takes his new position with a wide experience of sales promotion and trade development. As publicity manager of the society, which represents the co-operative electrical interests of the United States, he organized and successfully directed the work of the local committees and the publicity and sales work of both "Electrical Prosperity Week 1915" and "America's Electrical Week

Harry W. Alexander.

1916" campaigns. Prior to coming with the society in 1914, he was sales manager of the Federal Light & Traction Company, New York, a large syndicate public utility operating company. Earlier, he was a financial and political writer on one of the leading Chicago newspapers. Mr. Alexander is succeeded by Roy B. Woolley, now in the society's publicity and sales department, but late of the American Ambulance Field Service, Verdun sector, France. Mr. Woolley was formerly sales manager, Standard Electric Stove Company, Toledo, and one time associated with the MacManus-Kelley Company, Toledo, and the F. Bissell Company, of Toledo.

M. L. HIBBARD, manager of the Union Light, Heat & Power Company, Fargo, N. D., was elected president of the Associated Charities of Fargo for the year 1918.

JOHN C. MAHONEY, formerly connected with the General Electric Company at Atlanta, Ga., as district turbine inspector, has become associated with the Schenectady office of that concern.

J. G. GIRARD of Miami, Ariz., was recently appointed engineer in charge of the construction of a hydroelectric plant on the Colorado river.

CHARLES FRANCIS ADAMS, Boston, Mass., has been elected a member of the executive committee of the Edison Electric Illuminating Company of Boston, by the board of directors, succeeding C. Minot Weld, resigned.

JOHN S. WISE, general manager of the Harwood Electric and the Lehigh Navigation Electric companies, Hanto, Pa., has been appointed general manager and president of the Lehigh Valley Light & Power Company, Allentown, Pa.

GEORGE H. WILMARTH, formerly manager of the Sapulpa Electric Company, Sapulpa, Okla., has been appointed manager of the Muskogee Gas & Electric Company, Muskogee, Okla., succeeding J. E. Owens, who has been promoted to higher duties.

EDWARD R. KELSEY, publicity manager of the Rail-Light Company, is the author of an article entitled "The Nut Family" appearing in the February number of the National Sportsmen's Magazine, which deals largely with the eccentricities of the tribe of angling.

J. G. SANDIDGE, who for the past few years has been associated with the Chicago office of the Cooper Hewitt Electric Company, Hoboken, N. J., as district salesman, is now located at 1011 Majestic building, Milwaukee, Wis., and will look after the interests of the company in that vicinity.

V. L. BLANCHARD, formerly special representative of the new business department of the Brush Electric Company at Toledo, Ohio, has returned to Galveston where he will act as new business manager of the company. He succeeds Robert A. Wood who resigned to take charge of Christian Science army camp work in Texas.

J. C. BERTSCH, formerly refrigerating engineer of the Westinghouse Electric & Manufacturing Company, East Pittsburgh, Pa., has opened an office in Pittsburgh as consulting engineer. Mr. Bertsch will specialize in refrigeration for marine service, rubber mills and gasoline extracting, also in thermo-compressors for air, steam and ammonia.

J. E. NORTH, formerly new business manager of the Springfield Light, Heat & Power Company, has been elected secretary of the Chamber of Commerce of Springfield, Ohio. He was the first chairman of the new business co-operations committee of the association, and by his excellent judgment and management made that committee one of the leading electrical committees in the United States. Mr. North has for the last eight years been new business manager of the Springfield company, during which time the business of that company has grown tremendously.

JOE E. KING, local superintendent for the Southern Sierras Power Company, Corona, Cal., has been transferred to a similar position at San Bernandino.

JOSEPH B. MILGRAM, formerly connected with the Philadelphia Postal Telegraph Company, has been promoted to the rank of sergeant in the Aero Corps.

J. I. MATTHIAS has resigned his position as manager of the Leominster Electric Light & Gas Company, Leominster, Mass., and will engage in business for himself.

C. I. WEAVER, Jackson, Mich., has become connected with the Springfield Light, Heat & Power Company, Springfield, Ohio, as general manager, to succeed Weare Parsons.

H. P. CURTISS has been appointed representative of the New England States of the Clarage Fan Company, of Kalamazoo, Mich., with offices at 120 Milk street, Boston, Mass.

GEORGE W. SMIDT, formerly power engineer of the Dubuque Electric Company, Dubuque, Iowa, has accepted a similar position with the Northern Ohio Traction & Light Company, Akron, Ohio.

CARL A. WOLFROM, assisting operating manager of the Utah Power & Light Company, Salt Lake City, Utah, has been promoted to the position of district manager at Rexburg, Idaho, succeeding George Oates who resigned.

JOSEPH BAMBERGER, who for the past ten years has been connected with the Northern Indiana Gas & Electric Company, Lafayette, Ind., has accepted a position as assistant engineer of the Wabash Valley Electric Company, Clinton, Ind.

W. F. GEORGES, formerly of the Western Electric Company of Cincinnati and New York, has joined the sales organization of the Trumbull Electric Manufacturing Company, with headquarters at 114 Liberty street, New York City, and will represent that concern in eastern territory.

E. C. FABER, formerly traffic manager of the Traffic Bureau of the Electric Railway War Board of the American Electric Railway Association, has been appointed manager of the War Board. This is a new position created as part of the reorganization following the resignation of C. Loomis Allen as director.

B. W. COWPERTHWAIT, who was elected president of the Minnesota Electrical Association at its annual convention in Minneapolis, on March 13, is one of the best known utility men in the state. He was born in Danbury, Conn., and received his early education in the schools of that city. Upon finishing school he entered the service of the Danbury & Bethel Gas & Electric Company and left that position in 1901 to assume the management of the Faribault Gas & Electric Company, Faribault Minn., for Mr. C. A. Coffin. In 1909 this property was taken over by H. M. Byllesby & Company, together with properties in adjoining towns, and the Consumers Power Company, now the Northern States Power Company, was organized. Mr. Cowperthwait was at that time appointed manager of the Faribault Division of the company, which at present comprises 34 communities. About a year ago when the principal office was removed to Minneapolis, he became assistant general manager.

FRANK R. COATES, president of the Toledo Railways & Light Company, Toledo, Ohio, has been elected first vice-president of the National Baseball Federation.

HAROLD GOODWIN, JR., superintendent of distribution of the Philadelphia Electric Company, Philadelphia, Pa., has been called for active service in the Navy.

DR. F. G. KEYES, formerly chief engineer of the Cooper Hewitt Electric Company, Hoboken, N. J., has received the commission of captain in the Chemical Section of the National Army.

DENNIS G. HUGHES, a member of the firm of Langdon & Hughes, electrical contractors and dealers of Utica, N. Y., recently joined the colors and will serve with the Metropolitan Hospital Unit.

FRED E. STERLING, a member of the Illinois Public Utilities Commission, will become a candidate for the republican nomination for state treasurer of Illinois. Mr. Sterling is editor of the Republican-Register of Rockford, Ill., and was chairman of the Illinois state republican committee in 1912.

H. C. WILDER, secretary and treasurer of the Malone Light & Power Company, Malone, N. Y., has been commissioned a captain in the 309th heavy field artillery at Camp Dix, Wrightstown, N. J.

WALTER B. CLARKSON, for the past 10 years associated with the Bell Telephone Company of Pennsylvania in various capacities, and since 1910 division manager of the Pittsburgh branch, has been appointed general commercial superintendent of the Chesapeake & Potomac Telephone Company.

JOHN E. BOISSEAU, acting general commercial superintendent of the Chesapeake & Potomac Telephone Company, Baltimore, Md., has been appointed publicity manager of the Bell Telephone Company of Pennsylvania and Associated Companies, with headquarters at Philadelphia.

JAMES B. BLACK, formerly assistant general agent of the Great Western Power Company, San Francisco, Cal., has been appointed general sales manager of the Great Western System, succeeding W. W. Briggs, resigned. The Great Western System operates jointly the properties of the Great Western Power Company, Great Western Power Company of California and the City Electric Company.

FRED B. DUNCAN, a well known electrical engineer, has become associated with the Packard Electric Company, of Warren, Ohio, whom he will serve as a salesman. He will have charge of the Chicago office located in the Lees building and will look after both the transformer and cable division of the company in the district assigned him. Mr. Duncan was an attendant of Knox College at Galesburg, Ill., and the student course at the Western Electric Company, Hawthorne, Ill. Shortly after his graduation, he became connected with the J. Long Electric Company, Chicago, and in 1916 was appointed assistant chief engineer of the power and light plants of the International Harvester Corporation. Mr. Duncan was at one time vice-president of the Electrical Sales Engineers of Chicago, and is a member of the Electrical Club and Jovian League.

LYNN S. WHITAKER, purchasing agent, plant department, of the Southwestern Bell Telephone System, St. Louis, Mo., has enlisted in the Signal Corps. Mr. Whitaker bears the rank of first lieutenant and will be connected with the signal department as a supply officer.

AMERICAN INSTITUTE OF ELECTRIC ENGINEERS has added the following names of members to its roll of honor since the publication of the February issue of its Proceedings: Philip L. Alger, Lucien Carr, Richard C. Cheeny, Walter F. Collins, L. J. Corbett, J. M. Brodie, W. R. Davis, George S. Diehl, George De LaRochette, Theodore H. Dillon, R. E. Franklin, Tatsuo Furuichi, William H. Haines, S. H. Hancox, George L. Hedges, Arthur J. Holman, Nelson Jones, Austin L. Kimball, C. P. Knost, W. R. LaMotte, Albert Lorch, R. L. Lunsford, Hugo H. Lupinski, S. M. McFedries, S. E. Moore, Norman I. Moultrop, Horace B. Nye, W. B. Owen, Jr., Herbert E. Pawson, Emile G. Sacquet, A. B. Stewart, W. J. Strieby, Leon H. Webber, S. Edgar Whitaker, Edwin P. Williams and B. V. H. Yardley. This supplementary list brings the total of members now serving with the army and navy up to 721 names.

Obituary.

HOWARD E. AHRENS, Reading, Pa., president of the Allentown & Reading Traction Company, died recently at the age of 64 years.

W. B. SELL, formerly of the Milwaukee and Cincinnati offices of the Allis-Chalmers Manufacturing Company, but lately assistant district manager of the Pittsburgh office, died of pneumonia March 4 after an illness of only two days.

FRANK MACKAN, chief engineer of the Marysville Light & Water Company, Marysville, Ohio, died in that city on January 26. Mr. MacKan was for five years chief engineer of the electric light plant of the city, and was honored and respected by all who knew him.

HARRY SMITH MORROW, of New York, a well known hydraulic engineer, died on March 4, aged 44 years. Mr. Morrow was in charge of the building of the Whitney (N. C.) dam and water works, a section of the New York State Barge Canal, and the installation of a pipe line bringing New York City's water supply 900 feet under the Hudson river from Storm Mountain.

CHARLES H. WILLIAMS, who was known to the majority of the Doherty public utility operators, died in Denver on March 10 of pneumonia at the age of 44 years. Mr. Williams was a graduate of the University of Wisconsin, class of 1896, and was a classmate of Holton H. Scott, general manager of operations of the Doherty organization, and was one of the first college engineers to work for Henry L. Doherty. This was at the Madison (Wis.) Gas & Electric Company in 1897. Subsequently he became general superintendent of that company, and in 1905 was made manager of the Wisconsin Light & Power Company at La Crosse, Wis. He later went West with the Northern Colorado Power Company at a time when William J. Barker, now vice-president and general manager of the Denver Gas & Electric Light Company, was president. For the last six years Mr. Williams had been engaged in building and operating gas and electric plants in many of the smaller cities of the West.

Recent Patents

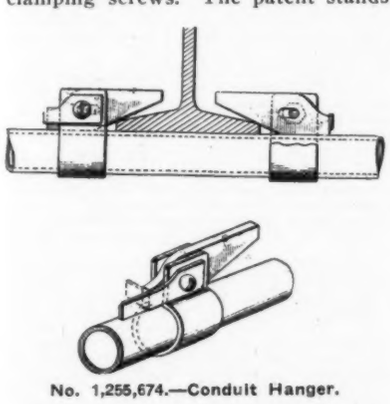
Selected and Summarized by Albert Scheible, Patent Attorney, 79 West Monroe Street, Chicago, Illinois

A series of brief comments on some of the recently issued electrical patents which appear to be of particular interest to our readers, the number after each heading being that of the United States patent to which the summary relates. Any correspondence regarding such patent matters should be sent direct to Mr. Scheible at the above address.

Welding High-Speed Steel (1,253,189).—To weld a flat piece of high-speed steel to the flat surface of another piece of metal, Edmund J. von Henke, of Lynn, Mass., corrugates the surfaces of both. Then he butts them against each other with the grooves crossing each other and applies the welding current for heating the contacting portions. The patent stands assigned to the Thomson Electric Welding Company, of Lynn, Mass.

Storage-Battery Separator (1,256,864).—For separating the plates in secondary cells, Julius Becker, of Chicago, uses a pasty mixture of volcanic ash, calcium sulphate and sulphuric acid.

Conduit Hanger (1,255,674).—In fastening conduit to steel beams, Albert J. Wayman uses tapering locking tongues which rest on the webs of the beams and are pivoted on the clamping screws. The patent stands



No. 1,255,674.—Conduit Hanger.

assigned to the Efficiency Electric Co., of East Palestine, Ohio.

Precipitating Particles from Streams (1,252,104).—In precipitating matter electrically from fluid streams, the deposits gradually build up on the boundary of the stream and may decrease the distance between the electrode to a point where the available voltage practically short-circuits the apparatus. To overcome this danger, Charles W. Girvin, of Philadelphia, establishes a permanently inactive zone in the electric field, so that the deposit-laden boundary can be shifted to this zone and the deposits removed from it.

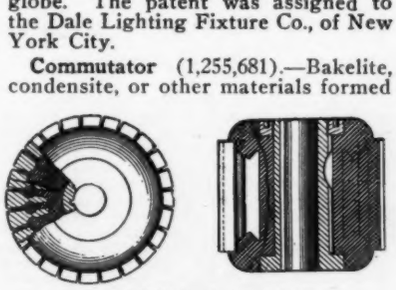
Measuring Voltage Maximum (1,254,620).—To measure the maximum value of a voltage wave, Max G. Newman, of Lanesboro, Mass., first charges a condenser with the voltage which is to be measured. Then he connects a separate source of direct current to the condenser and adjusts the potential of this direct current until a galvanometer in series with this source shows no deflection, and measures the adjusted potential of the direct current applied for this purpose. The patent stands assigned to the General Electric Company.

Shade-Holder (1,256,411).—To make a cheap shade-holder, Arthur A. Wiedenhoeft makes a single metal stamping with an outer flange carrying the usual screws to underhang the rim of the shade. The inner part of the stamping has an unbroken ring bearing against the lower side of the bead on the lamp socket, and spring fingers bearing against the upper side of this bead.

For Telephone Secrecy (1,256,123).—George I. Galitzka, of New York City, aims to prevent the operator of a local switchboard from listening in on the local circuits. For this purpose he provides a visible warning signal at each telephone, which is operated when the operator moves her listening-in key.

Electric Light Fixture (1,254,210).—For gas-filled lamps, John H. Dale provides a chimney-type holder with a series of metal spinnings between the chimney proper and the globe inclosing the lamp, thus affording passages for cooling the chimney as well as for ventilating the interior of the globe. The patent was assigned to the Dale Lighting Fixture Co., of New York City.

Commutator (1,255,681).—Bakelite, condensite, or other materials formed



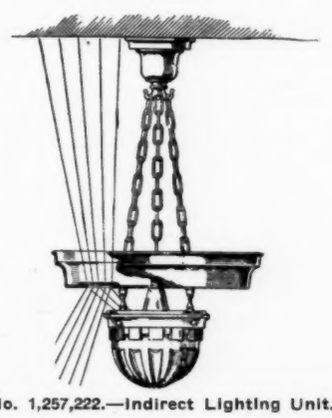
No. 1,255,681.—Commutator.

by chemically condensing phenols together with an aldehyde, are used by Charles C. Lenk, of Wilkinsburg, Pa., in molding a commutator, the idea being to set the segments into a mold and then force the hot bakelite into place. The patent was applied for in 1912 and stands assigned to the Diehl Mfg. Co., of Elizabeth, N. J.

Alloy for Resistances (1,257,272).—Guy M. Laird, of Chicago, has patented an electric resistance element, presumably intended for electric heaters and consisting of an alloy of nickel, cobalt and silicon, with at least 75 percent of nickel.

Damping Telephone Transmitters (1,255,861).—In this transmitter, designed by Irving D. Crandall, of New York, the center of the diaphragm has the usual connection to a variable resistance, while the vibrations in the rim portion of the diaphragm are damped by a finely divided metal. Aluminum or magnesium are mentioned for this purpose, and the patent stands assigned to the General Electric Company.

Indirect Lighting Unit (1,257,222).—To overcome the shadow cast on the ceiling by a flat reflector suspended over the lamp and at some distance from the ceiling, Edwin F. Guth perforates the reflector and



No. 1,257,222.—Indirect Lighting Unit.

covers the perforations with opal glass. This opal glass reflects a part of the light rays, so that the efficiency of the reflector is not materially decreased, while the glass also permits part of the rays to overcome the shadow on the ceiling. The patent was assigned to the Luminous Unit Co., of St. Louis, Mo.

Voltage Regulation for Rectifiers (1,257,426).—William Tschudy, of Wilkinsburg, Pa., and Sidney W. Farnsworth, of Pittsburgh, Pa., regulate the voltage drop in a vapor rectifier in accordance with the amperage of the rectified circuit. The solenoid used for this purpose controls a valve which regulates the cooling of the cathode. The patent was assigned to the Westinghouse Electric & Mfg. Co.

Storage-Battery Box (1,257,931).—By adding a funnel-shaped extension to the bottom of a storage-battery container, Walter C. Rowell, of Santa Ana, Cal., provides a pocket in which the sediment may collect and from which it may be drained.

Current News

Weekly Record of Construction Activities—Conventions

EASTERN STATES.

CAMBRIDGE, MASS.—Cambridge Electric Light Company, 46 Blackstone street, has taken bids for the construction of a one-story addition to its power plant, about 30x50 feet.

EAST HAMPTON, MASS.—Glendale Elastic Fabrics Company has commenced the construction of a power plant and switchroom at its plant in connection with other improvements. The structure will be one-story, about 65x75 feet in size, and is estimated to cost $10,000. The Casper Ranger Construction Company, 29 Bond street, Holyoke, is the contractor.

WORCESTER, MASS.—The W. H. Sawyer Lumber Company, 66 Lincoln street, is having plans prepared for the construction of a power house in connection with its new plant on Lincoln street, the entire work being estimated to cost $70,000.

FORESTVILLE, CONN.—Fire on March 10, completely destroyed the power plant of the Feck & Young Manufacturing Company.

BINGHAMTON, N. Y.—Binghamton Light, Heat & Power Company has contracted for an additional 300 horsepower with two manufacturing concerns, due to the flood water destroying a portion of a dam in the Susquehanna river, making the water power plants of the companies useless.

BUFFALO, N. Y.—Demarest Heating Corporation, 21 The Terrace, has filed notice with the Public Service Commission of an increase in its capital from $10,000 to $50,000, to provide for expansion.

BUFFALO, N. Y.—National Aniline & Chemical Company, Abbott Road, has taken out a building permit for the construction of a power house at its plant to cost about $8500.

BUFFALO, N. Y.—Fire on March 14 seriously damaged the plant of the Sterns Electric Equipment Company, 66-70 Broadway, manufacturer of electrical supplies, etc., with a loss estimated at approximately $40,000.

BUFFALO, N. Y.—Frontier Water & Steam Supply Company, 667 Main street, has filed notice with the Public Service Commission of an increase in its capital from $40,000 to $150,000 to provide for expansion.

BUFFALO, N. Y.—Lackawanna Steel Company, Hamburg Turnpike, is having plans prepared for the construction of a one-story central turbo-generator power plant at its works. The structure will be 100x190 feet in size, and is estimated to cost $200,000.

BUFFALO, N. Y.—The City Council has authorized the issue of bonds to the amount of $60,000, to provide for the laying of an underground conduit system for the police and fire departments, replacing the present overhead wires.

DUNKIRK, N. Y.—Dunkirk Electrical Manufacturing Company, manufacturer of electrical supplies, etc., has filed notice with the Public Service Commission of the dissolution of the company.

JAMESTOWN, N. Y.—Crescent Toll Company, 202 Harrison street, is having plans prepared for the construction of a power station at its plant.

LOCKPORT, N. Y.—Lockport Light, Heat & Power Company, 111 Main street, has filed notice with the Public Service Commission of an increase in its capital from $150,000 to $350,000 to provide for improvements, extensions, etc.

NEW HAMPTON, N. Y.—The Department of Corrections, Municipal building, New York, has commenced the construction of a power house at the local reformatory. Nelson & Miller, 189 West Main street, Middletown, N. Y., are the contractors. Burdette G. Lewis is commissioner.

NEW YORK, N. Y.—Mexican Telegraph Company has acquired property on Broad street, comprising one entire block from South William to Stone street, about 3100 square feet, and is said to be planning for the construction of a large administration building. The property was held at $150,000, and it is reported that the entire project will represent an expenditure of approximately $700,000. James A. Scrymser is president.

WEST NEW BRIGHTON, S. I., N. Y.—New York Telephone Company, 15 Dey street, New York, is considering the erection of an addition to its local telephone building, to be of brick and stone construction.

DOVER, N. J.—The new addition to the plant of the New Jersey Power & Light Company to provide for the installation of a 3500 kilowatt turbine, is rapidly nearing completion, and it is expected that the new unit will be on hand for installation as soon as the building is ready. The new boilers are being installed and when completed will provide in turbines and boilers a capacity of $7000 kilowatt.

JERSEY CITY, N. J.—Until April 3, the Boulevard Commission will receive bids for new lamps, generators, and other appliances to be used in connection with the new electric lighting system for the boulevard.

NETCONG, N. J.—Common Council is planning for extensive improvements in its electric street-lighting system, including the installation of increased candlepower lamps throughout Main street for a "white way" system.

NEWARK, N. J.—Maas & Walstein, Inc., Avenue R, have recently taken out a building permit for the construction of an addition to power plant and alterations in the boiler room. The estimated cost of the work is $12,000.

JERSEY CITY, N. J.—General Storage Battery & Repair Company is planning to increase its present capacity and is making improvements and additions to its plant.

TRENTON, N. J.—Crescent Insulated Wire & Cable Company, Olden and Taylor streets, manufacturers of electrical wires, cables, etc., has acquired property at 319-21 North Olden avenue, and is said to be planning to use it for extensions to its present plant. The property has a frontage of about 275 feet on Taylor street and 110 feet on North Olden avenue.

TRENTON, N. J.—The City Commissioners are considering plans for the early construction of a large hydroelectric plant on Sanhican Creek, to be used for municipal purposes.

HARRISBURG, PA.—Harrisburg Railways Company has formally inaugurated operations in its new power station at Reily and Marion streets, making it possible to supply power for the operation of its Second, Third, Fourth, Six street and Rockville traction lines from the York Haven plant, the current being carried over the lines from the transformers at the new station.

NANTICOKE, PA.—The board of managers of the State Hospital has awarded a contract for the construction of a one-story power house, about 50x65 feet, at the institution, to be erected in connection with other additions. John Curtis & Company, 1 Hickory street, Wilkes-Barre, is the contractor.

PACKERTOWN, PA.—Carbon Transit Company is considering the extension of its lines from Packertown to Jamestown, a distance of about one mile.

PHILADELPHIA, PA.—Notice has been filed with the Public Service Commission by the Philadelphia Electric Company of a bond issue of $4,000,000 and the issuance of notes for $7,500,000, to provide for improvements, extensions, etc.

STEELTON, PA.—Bethlehem Steel Company is making rapid progress in the construction of a boiler plant at its works, located near Swatara street. Immediately upon completion of the structure, the company will commence the installation of four boilers having a capacity of 250 horsepower each.

SUNBURY, PA.—Northumberland County Gas & Electric Company, which operates in Sunbury, Milton, Danville, and Bloomsburg, has been granted permission by the Public Service Commission to increase its rates for gas for all consumers 10 per cent, and rates for industrial users of electricity slightly less than 10 per cent.

TANEYTOWN, PA.—Plans are under way for the building of an electric line from Havre De Grace to Taneytown. The officers of the new company are C. S. Stirling, president; J. Frank Foster, vice-president; James P. Reese, secretary, and George O'Brien, treasurer.

WASHINGTON, D. C.—A bill has been introduced by Senator Sheppard of Texas, authorizing the Government to take over and operate all telegraph or telephone communication, cables, and wireless stations.

FINCASTLE, VA.—Roanoke & Botetourt Telephone Company has filed notice of an increase in its capitalization from $10,000 to $15,000, to provide for expansion.

NEWPORT NEWS, VA.—Chesapeake & Potomac Telephone Company is planning for the construction of a telephone exchange plant. P. G. Burton, 108 East Lexington street, Baltimore, Md., is engineer. M. H. Buehler is general manager.

PETERSBURG, VA.—Virginia Railway & Power Company, Richmond, is planning for the immediate construction of a high power transmission system from Petersburg to Norfolk, to provide for the distribution of electricity for lighting and power purposes in Petersburg and Norfolk and immediate small towns. It is said that the project, which will cost approximately $750,000, will be completed during the coming fall.

GREENVILLE, S. C.—Gower-Mason Electric Company, 103 West Washington street, recently incorporated with a capital of $35,000 to engage in an electrical contracting capacity, has completed its organization plans. The company succeeds the Gower-McBee Electric Company.

ALBANY, GA.—Albany Power & Manufacturing Company, which operates a 50-mile transmission system connecting Albany, Leesburg, and Putney, is considering the immediate installation of a 600 horsepower watertube boiler in its plant. E. L. Killebrew is superintendent.

NORTH CENTRAL STATES.

ATTICA, IND.—Municipal Electric Light & Water Plant was recently burned with an estimated loss of $60,000 with $9,000 insurance. The electrical equipment was totally destroyed and the city is without lights. Steps have been taken to finance a new plant which will be erected as soon as possible and $100,000 has been pledged for the project.

CHARLESTON, ILL.—Charleston Electric Company has asked permission of the Illinois Public Utilities Commission to increase its rates for electric service.

ELKHART, IND.—The Home Telephone Company has asked permission of the Indiana Public Service Commission to issue 3000 shares of cumulative preferred capital stock of the par value of

$100 a share, bearing interest at 6 per cent.

GARY, IND.—Gary Street Railway Company has certified to the Indiana secretary of state for an increase in its capital stock from $10,000 to $730,500.

LA SALLE, ILL.—Citizens Lighting Company has applied to the Illinois Public Utilities Commission for permission to increase its rates for gas service in La Salle, Peru and surrounding territory.

CHARLEVOIX, MICH.—The proposition to issue bonds for $85,000 to purchase the Hydraulic Power & Light Company dam and electric power plant at Bellaire will be submitted for vote at the election to be held in April.

ANTIGO, WIS.—Antigo Electric Company has received a contract for street lighting. Address John Manser, president.

REEDSBURG, WIS. — Improvements are contemplated to the municipal electric light plant, including the installation of an electric generating unit of 250 or 300 kilowatts, directly connected to either the uniflow engine or steam turbine. Address Otto F. Luepke, superintendent.

STEVENS POINT, WIS.—Lightless nights have been discontinued here as no coal is used in the production of the electric current. The city receives its current over transmission lines from Mosines, Wis., and other points where the plants are operated by waterpower.

SUFERIOR, WIS.—Edward Kaner has purchased a site and will erect buildings to be equipped with electric cranes.

GLYNDON, MINN. — Glyndon Light Company is arranging for the installation of additional street lamps.

SIOUX CITY, IOWA.—Improvements costing approximately $500,000 have practically been completed by the Sioux City Service Company. Among these are included the installation of a substation, a turbine and two boilers installed at the main power station, forming a complete generating unit, new switchboards, underground work and a transmission line to Riverside.

LORIMER, IOWA.—A franchise has been granted the Lorimer Light & Power Company for an electric transmission line in Union County. Address J. F. Smith.

WATERLOO, IOWA.—A franchise has been granted the Citizens' Gas & Electric Company for an electric transmission line in Black Hawk County. Address the local manager.

PLEASANT HILL, MO.—Green Light & Power Company owned by I. E. Green & Sons has bought the Garden City light plant operated there by Kauffman & Son. A line will be run to Garden City soon.

CANEY, KANS.—Unless the Kansas Light & Power Company, which owns the electric light and power plant of this city repairs its plant within 90 days and gives the city a greatly improved service, the city will take over and operate the plant. The electric light plant burned down about a year ago, and since that time has been taken over by a Duluth concern under the name of the Kansas Light & Power Company. The company started to rebuild the plant and gave the city service but the plant has never been rebuilt to any considerable extent and the services have not been adequate.

DODGE CITY, KANS.—The electric light franchise issue will not be submitted at city election. Mayor Hale said that no franchise ordinance was to be submitted unless a legal petition requiring the commissioners to submit one should be filed.

EL DORADO, KANS.—The city commissioners recently voted to extend the system of ornamental street lighting.

GARDNER, KANS.—At the meeting of the city council recently, Mr. Bushong of Ottawa appeared and made a statement concerning the cost of installing an electric light plant for Gardner. With a transmission line plant he estimated the cost at about $17,000 and with a power plant, the cost would be in the neighborhood of $21,000. After hearing his statement, the mayor appointed councilmen Williams, Cramer and Ayres to visit some nearby towns where Mr. Bushong has installed plants with a view to obtaining as much information as possible concerning their cost, operating and service. The committee will report at the next meeting.

DATES AHEAD.

Wisconsin Electric Association. Annual meeting, Pfister Hotel, Milwaukee, March 27-28, 1918. Secretary, George Allison, 1419 First National Bank building, Milwaukee, Wis.

Tri-State Water & Light Association. Annual meeting. Charlotte, N. C., April, 1918. Secretary-Treasurer, W. F. Steiglitz, Columbia, S. C.

Southwestern Electrical & Gas Association. Annual convention, Galvez Hotel, Galveston, Tex., April 15-16. Secretary, H. S. Cooper, 405 Slaughter building, Dallas, Texas.

American Association of Engineers. Annual meeting, May 14, 1918. Secretary-Treasurer, A. H. Krom, 29 South La Salle street, Chicago.

Arkansas Association of Public Utility Operation. Annual convention, Arlington Hotel, Hot Springs, Ark. May 21-22-23. Secretary-Treasurer, R. B. Fowles, Pine Bluff, Ark.

Electrical Supply Jobbers' Association. Annual meeting, Homestead Hotel, Hot Springs, Va. May 28-30. Secretary, Franklin Overbagh, 411 South Clinton street, Chicago.

Electrical Contractors' Association of Georgia. Annual meeting, Tybee Island, Ga., June, 1918. Secretary, Dan Carey, 614 Chamber of Commerce building, Atlanta, Ga.

National Electrical Credit Association. Annual meeting, June 1, 1918. Secretary, Frederic P. Vose, 1350 Marquette building, Chicago, Ill.

Texas State Association of Electrical Contractors. Annual meeting, Galveston, Tex., June 15, 1918. Secretary, H. S. Ashley, Fort Worth, Tex.

Southeastern Section, National Electric Light Association. Annual meeting, June 19-20, 1918. Atlanta, Ga. Secretary-Treasurer, T. W. Peters, Columbus, Ga.

American Institute of Chemical Engineers. Summer meeting, Berlin, N. H., June 19-22. Headquarters, Mt. Madison House, Gorham, N. H. Secretary, John C. Olsen, Brooklyn, N. Y.

Northwest Electric Light & Power Association; affiliated with N. E. L. A. Annual meeting, September 11, 1918. Secretary, George L. Myers, Pacific Power & Light Company, Portland, Ore.

LARNED, KANS.—Mayor Frizell asked the council recently to consider what would be a fair and reasonable price at which the city could afford to furnish current for use by some of the neighboring towns, as a proposition was likely to be made to the city in the near future by these towns. It is understood that Garfield, and possibly Lewis and Belpre may be interested in the rate Larned could make for current.

LEON, KANS.—W. B. Rollins & Company, engineers of Kansas City, have prepared plans for the proposed electric light plant to be erected at a cost of $17,000. Address Charles S. Palmer, city clerk.

RANDOLPH, KANS.—An ordinance has been passed providing for a contract with the Riverside Light, Power & Gas Company, Abilene, Kans., for furnishing electric current and lights for the streets in Randolph. H. E. Pfuetz, city clerk.

WESTMORELAND, KANS. — Westmoreland has an opportunity to secure electric lights without voting bonds. C. H. Holden of Abilene is representative of the Riverside Light, Power & Gas Company and of the Rocky Ford plant, was in the city recently talking about the proposition with the business men, and met with much encouragement. All the company asks is that enough coupon books be sold to guarantee the expense of building the line here.

LINCOLN, NEB.—The state board is considering the advisability of connecting the state house with a local light plant for the reason that the penitentiary plant, owned by the state, sometimes breaks down, and for short periods the state house is in darkness. The Lincoln Traction Company has offered to build a connecting line from Twelfth and K streets to the state's line if the state will pay $250 to cover the expense of construction and pay regular rates for current in emergencies.

LINCOLN, NEB.—The state board of irrigation at a meeting March 2 cancelled the application of J. F. Johnson of Milford for power site on Blue river south of Crete and allowed application of H. B. Babson of Chicago for same site. Mr. Babson is interested with Burdete Boyes of Seward in several power sites on the Blue river. He filed a bond for $1000 to begin work of construction within six months before the board granted his application.

UPLAND, NEB.—A new $6500 municipal electric light plant will be installed here.

MILLER, S. DAK.—An election will be held to vote on a bond issue of $30,000 for a light and power plant and $15,000 for city water works system.

SOUTH CENTRAL STATES.

COLUMBIA, TENN.—John B. Ashton, Columbia, and associates, are arranging plans for the organization of a company to engage in the construction of a large hydroelectric plant on the Duck River. M. R. Stern, of Nashville, is also interested in the proposed concern.

SEWANEE, TENN.—Sewanee Telephone Company is considering plans for the reconstruction of its telephone exchange plant recently destroyed by fire.

COLUMBIA, ALA.—Tucker & Laxton, Inc., Charlotte, N. C., has commenced work on the enlargement of the Omussee plant of the Columbia Power Company at a cost of about $500,000. The company will also establish a plant at Kelso to cost approximately $500,000.

ROGERS, ARK.—A resolution has been adopted by the city council favoring the purchase of the electric light and power plant by the city.

ARNETT, OKLA.—E. M. Beum has bought the half interest of H. C. Brownless in the Arnett Light & Power Company.

BLACKWELL, OKLA.—Election to vote bonds to improve the waterworks and electric light plant carried.

CHICKASHA, OKLA.—Oklahoma corporation commission has granted a six-cent fare to the Chickasha Street Railway Company.

LAVERNE, OKLA.—The city, which recently issued bonds for $13,000, has taken over and will operate the plant of the Laverne Light, Power & Ice Company.

MADILL, OKLA.—The erection of a new plant is contemplated by the Consumers Light & Power Company.

SHATTUCK, OKLA.—The city is considering plans for extensive improvements and additions to the electric light and water plants. J. C. Fowler, secretary.

RYAN, OKLA.—Jasper L. Roberts, superintendent of the Water & Light Department and Councilman J. R. Dean are in the market for some machinery for the water and light department. It is planned to install a crude oil burner engine.

SHATTUCK, OKLA.—An election will be held soon to vote $75,000 bonds for waterworks and electrical improvements. Burns & McDonnell, 402 Interstate building, Kansas City, Mo., engineers.

DEL RIO, TEX.—A. W. Houston, general superintendent of the Texas Gas & Electric Company, states that the system of ornamental street lights will be extended here.

DENISON, TEX.—It is probable that a bond issue for the purpose of erecting a municipal light and power plant will be submitted for vote in the near future. It is the opinion held by many that upwards of $100,000 should be voted to erect such a plant.

WESTERN STATES.

MANVILLE, WYO.—A $30,000 light plant will be built here soon.

STERLING, COLO.—Ornamental electric light poles will probably be installed soon.

COLUMBUS, N. M.—A new power plant to generate electric current for this town and Camp Furlong will be installed

at a cost of $30,000 according to J. L. Greenwood, principal owner of the Columbus Electric Light & Power Company.

SANTA FE, N. M.—At a recent meeting of the city council, February 27, a resolution introduced by Alderman George W. Armijo was passed authorizing the selection of a committee to ascertain the value of the property of Santa Fe Water & Light Company, in view of the expiration of the franchise granted the city in that company, and to consider whether the city should take over the water and light plant.

CHEHALIS, WASH.—On April 20 the question of granting a power and light franchise to O. E. Anderson of Portland will be submitted to the voters.

CHEHALIS, WASH.—Central Light & Power Manufacturing Company files petition with the commissioners of Lewis County for a franchise to construct and operate electric light and power line between the towns of Walville and Meskill, a distance of 12 miles.

SEATTLE, WASH.—The Puget Sound Traction, Light & Power Company has applied to the city council for a franchise to operate a street railway line along Avalon Way and 36th avenue Southwest to the intersection of the latter street and West Snoqualmie street. The company submitted along with the request a proposed franchise ordinance providing for completion of the line within 12 months from the time the franchise is granted.

SEATTLE, WASH.—The Rothert Process Steel Company, with offices at 622 Harriman street, will add 100 feet to its smelter and install a 10-ton electric furnace.

SEATTLE, WASH.—Puget Sound Traction, Light & Power Company has been granted a permit to erect coal bunkers to cost $17,000 at 1316 Western avenue. Stone & Webster are the builders.

SPOKANE, WASH.—A contract for installing new ornamental curb lighting system on Post street was awarded to the Washington Water Power Company at $40,545.

PORTLAND, ORE.—Northwestern Electric Company, Pittock building, has been granted a permit to erect a $15,000 building at the foot of Lincoln street. Charles C. Moore & Company are the engineers.

INCORPORATIONS

MEMPHIS, TENN.—The Cumberland Electric Manufacturing Company. Nominal capital, $6000. To manufacture electrical supplies. Incorporators: H. A. Beckham, M. W. Nelson, and E. L. Nelson.

SAN BENITO, TEX.—The Commonwealth Water & Electric Company. Capital, $30,000. To operate a local plant. Incorporators: W. D. Carpenter, John T. Lomas, and S. Spears.

NASHVILLE, TENN.—The Rock City Electric Company. Capital, $50,000. To operate a plant for the generation and distribution of electricity. Incorporators: J. C. and W. C. Campbell, and H. S. Sumner.

ELK PARK, N. C.—The Elk Park Electric Light & Power Company. Capital, $25,000. Incorporators: A. P. Brinkley, A. P. Brinkley, Jr., and H. H. Brinkley.

WILMINGTON, N. C.—The Electrical Maintenance Company. Capital, $10,000. To engage as electrical engineers. Incorporators: M. C. McIntyre, C. R. Suggs, and J. C. Hobbs, Jr.

PITTSBURGH, PA.—The Rochester Bulb Corporation. Capital, $162,000. To manufacture electric bulbs, etc. Alexandre Saas, New York, is the principal incorporator.

ALINE, OKLA.—Al-Co Oil, Gas & Electric Company has incorporated with a capital of $100,000. L. J. Dixon, L. H. Stephens and I. A. O'Shaughnessy are the incorporators.

NASHVILLE, TENN.—Rock City Electric Company has been incorporated with a capital of $50,000. J. C. Campbell, W. C. Campbell and H. S. Sumner are the incorporators.

GRAFTON, ILL. — Grafton Electric Light & Power Company has been incorporated with a capital of $10,000. Wm. J. Brower, Robert L. Meyensburg, Aug. Miller, and others are the incorporators.

BIRMINGHAM, ALA.—Alabama Interurban Railway Company has been incorporated with a capital of $5,000,000 to build proposed line from Birmingham to Warrior River, 17 miles of construction. Incorporators are Thomas L. Cannon, H. M. Gassman and others.

NEW YORK, N. Y.—Santo Domingo Electric Light & Power Company. Capital, $300,000. To operate a plant for the generation, distribution, etc., of electricity. Incorporators: A. A. Oldrini, J. A. Losada, and A. M. Dieman, 50 Broad street.

NEW YORK, N. Y.—Display Stage Lighting Company. Capital, $10,000. To manufacture electrical supplies, fixtures, etc. Incorporators: W. E. Price, M. E. Kelly, and J. H. Ogham, 270 West Forty-fourth street.

OGDENSBURG, N. Y.—D. & F. Electrical Engineering Company. Capital, $10,000. To engage in a general electrical engineering capacity. Incorporators: S. J. Delaney, F. J. Francis, and A. T. Whalen, Ogdensburg.

DOVER, DEL.—Stanley Engineering Company. Capital, $4,000,000. To engage as electrical and mechanical engineers. Incorporators: M. M. Clancy, C. L. Rimlinger, and F. A. Armstrong, Wilmington.

HENDERSON, ILL.—Municipal Electric Light & Power Company has been incorporated with a capital of $1000. Jesse H. Baker, Edna N. Baker and Arella S. Button are the incorporators.

ELK PARK, N. C.—Elk Park Electric Light & Power Company has incorporated with a capital stock of $25,000. Incorporators: A. P. Brinkley and A. P. Brinkley, Jr.

ORANGEBURG, S. C. — Woodward-Wiggins Electric Company has been incorporated with a capital of $9000 by L. J. Woodward and J. C. Wiggins.

WACO, TEX.—Central Texas Battery Company has incorporated with a capital stock of $5000. Incorporators: W. H. Earle, G. B. Rogers and W. D. Meleer.

DUBOIS, IDA.—The Dubois Light & Power Company has filed articles of incorporation and selected power site; capital stock $25,000.

PADUCAH, TEX.—Paducah Electric Company has been incorporated with headquarters at Dallas and will build an electric light and power plant here at a cost of about $10,000. J. H. Barnes is a stockholder.

PHILADELPHIA, PA.—Power Developer Unit Corporation. Nominal capital, $5000. To manufacture electrical specialties. Incorporators: William J. Graham and Donald C. Scott, Philadelphia.

HENDERSON, ILL.—The Municipal Light and Power Company has been incorporated with capital of $1000. Jesse H. Baker, E. M. Baker and S. S. Button are the incorporators.

CANTON, OHIO.—Eclipse Electric Company was recently incorporated with a capital of $10,000. Charles A. Miller and N. W. Wirth are the incorporators.

NEW YORK, N. Y.—Victoria Sales Corporation. Capital, $30,000. To manufacture electric lamps for automobile service, etc. Incorporators: P. A. Larter, A. Ornstein, and F. A. Schilling, 647 Academy street.

BROOKLYN, N. Y.—Supreme Electrical Contracting Company. Nominal capital, $5000. To engage as electrical contractors. Incorporators: H. Rothenberg, E. E. Cohen, and H. Bertinger, 135 Broadway.

PROPOSALS

ELEVATOR.—Bids will be received by the Commission of Public Docks, Portland, Ore., up to April 9, 11 a. m., for the construction of an elevator, including transformer house, etc., to cost between $800,000 and $900,000. The bid is to be accompanied by certified check for 5 per cent of proposal on bank where capital is at least $100,000.

CONDUIT, INSULATORS, CABLE, ETC.—Bids will be received by the purchasing agent of the Alaskan Engineering Commission, Room 422 Bell street, Seattle, Wash., up to March 25, for furnishing the commission with electrical supplies, including 6600 feet of conduit, 40,000 insulators, 25,000 5/16 inch cable and about 100,000 feet of wire.

PUMPS AND EQUIPMENT.—Sealed proposals will be received at the Bureau of Yards and Docks, Navy Department, Washington, D. C., until March 25, for furnishing and supervising the installation of two 700-gallon-per-minute electrically-driven centrifugal booster pumps and equipment at the navy yard at Portsmouth, N. H.

CABLE, CORD AND WIRE.—Bids will be received by the Bureau of Supplies and Accounts, Navy Department, Washington, D. C., for the following supplies: 134,000 feet interior-communication, plain, leaded and armored cable, 400,000 feet twin, lamp cord, 50,700 feet lead-covered wire, 202,500 feet rubber-covered, duplex wire, 870,000 feet double-conductor, duplex, plain wire, leaded and armored, 140,000 feet double-conductor, duplex, armored wire, 260,000 feet single-conductor, plain wire, 158,000 feet single-conductor, leaded and armored, soft steel wire and 37,000 pounds weatherproof wire on reels, all of which material to be delivered at the navy yard at Brooklyn, N. Y. Bids for a miscellaneous quantity of plain, magnet, enameled wire for delivery at the Philadelphia (Pa.) navy yard will also be received by the Bureau.

NEW PUBLICATIONS

PERFORMANCE OF METALLIC FILAMENT LAMPS ON ALTERNATING CURRENT CIRCUITS is the title of Bulletin No. 17 recently published by the Engineering Experiment Station of the Pennsylvania State College, and deals with the effects of form of voltage wave on candlepower, efficiency and life on tungsten filament lamps. The test described in this bulletin is part of an extended investigation being conducted by the Pennsylvania State College Engineering Experiment Station and the measurements made in this connection are the work of D. L. Markle, H. D. Gruber and F. E. Field, instructors in this institution. In making these tests, one hundred 20 watt, 115 volt, tungsten filament lamps were used and 25 watt lamps were used to the exclusion of lamps of higher candlepowers in an effort to exaggerate any differences in performance which might develop during the test. Two test racks were constructed so that the lamps could be burned tip down with a horizontal distance of six inches between centers of adjacent lamps. The wiring of the racks was such that with all lamps burning, the maximum difference in potential between lamps subjected to the highest and lowest voltages was 0.032 per cent of the rated voltage of the lamps. To secure the alternating current waves on which the lamps were burned, a special harmonic generator was used. The test showed that the form of the voltage wave produced the following effects: First, the average candlepower of the lamps which survived the test was slightly higher in the case of the lamps burned on the sine wave than the average candlepower of those burned on the peaked wave, and the difference in the average candlepower at the end of 1,000 hours burning differed by only 2.13 per cent of the average initial candlepower of all the lamps. Second, the average efficiency of the lamps which survived the test was slightly higher for the lamps burned on the sine wave than for the lamps burned on the peaked wave. Third, the one marked difference in the performance of the lamps was found in the average life of the lamps burned on the two wave forms. Excessive breakage was observed among the lamps burned on the peaked wave, which numbered nearly five times that on the sine wave. Complete information in regard to the conduct of the test is given and a number of tables, charts, etc., are contained in the bulletin.

Financial News

Annual Report of Western Electric Company.

Western Electric Company, New York, N. Y., has issued its annual report in which the business of the past year shows a substantial increase over 1916. This is true of both the sale of its own manufactures and in the sale of merchandise not made by it. In the manufacture of its products, the demands from regular customers were very heavy at the beginning of the year, but as the demands for equipment to meet emergency requirements directly or indirectly caused by the war have increased, the ordinary requirements have decreased so that to a large extent a more expensive and less profitable business has been carried on by the company during the latter part of the year. The profits of the company for 1917 included no return from foreign investments.

On the entry of this nation into the war the Western Electric Company practically placed its engineering department at the service of the government and has rendered important service through this action. This has involved large expense and indirect loss through the interruption of its regular engineering program. On such orders as have been undertaken for the military departments, the company has agreed to a basis of cost plus a very moderate profit. On account of the large merchandise investment and the prevailing high costs $2,000,000 have been set aside to the Reserve for Contingencies and due to the greatly increased number of employees since the establishment of the Employees' Benefit Fund the sum of $500,000 has been added to that fund. The shop force of the Western Electric Company has increased during the year from 18,928 to 21,549 employees, bringing the total number of employees up to 30,737. The sales for 1917 were $150,340,000 as compared with $106,987,000 for 1916 and $63,852,000 for 1915. The orders on hand December 31, 1917, were $1,950,000 in value less than on December 31, 1916. The average value of an order filled during 1917 was $107 as compared with $75 for 1916.

Cities Service Bond Offering.

The Cities Service Company is offering $3,000,000 convertible 7 per cent bonds to stockholders for subscription, part of an authorized issue of $30,000,000. The offering is limited at par and is limited to present owners of stock, who may subscribe in the proportion of $5 of bonds for each $100 par value of common and preferred stocks held. The debentures may be converted into stock on and after January 1, 1920, each $100 of bonds being exchangeable for $80 of Cities Service preferred and $20 of common, together with an amount of stock and cash equal to the dividends declared and paid on an equal amount of common stock from January 1, 1918, to the date of conversion.

Union Electric & Power Notes.

The Union Electric & Power Company, St. Louis, Mo., has applied to the Missouri Public Service Commission for permission to sell $1,000,000 of two-year notes to be divided among the Mississippi Valley Trust Company, the Mercantile Trust Company and the Third National Bank. The notes will bear 6 per cent interest and will be secured by a deposit of $1,500,000 of refunding and extension mortgage bonds, bearing 6 per cent interest. The company has decided not to place the bonds on sale at the present time, owing to war conditions and has therefore asked permission of the Commission to issue the notes with the bonds as security.

Middle West Utilities Notes Issued.

The Middle West Utilities Company through Halsey, Stuart & Company, is offering 6 per cent collateral gold notes, series "C," selling at 95¼. These notes will mature November 1, 1920, and will yield 8 per cent interest payable semi-annually May 1 and November 1. The purpose of this issue is to meet the greatly increased demands for electricity and gas occasioned by the war and the Middle West Company will through the sale of these notes increase its capacity to meet these requirements. The Middle West Utilities Company, through its subsidiaries, operates public utility property in 14 states, serving 406 communities, located largely in the middle western portion of the country, and serves a population estimated at about 1,073,200. Of this number, 26,300, or 15.82 per cent, were new customers, 6,600 of which were due to newly acquired operating companies. These notes represent a well secured investment and are followed in security by $12,000,000 par value 6 per cent preferred stock and $9,848,475 dividend-paying common stock.

Montana Power Company Report.

Consolidated income account of the Montana Power Company, for the year ended December 31, 1917, compares as follows.

	1917.	1916.
Gross earnings	$6,905,256	$6,219,148
Net after expenses and taxes	4,881,924	4,727,525
Other income	7,108	25,757
Total income	$4,889,032	$4,753,282
Interest	1,395,604	1,319,735
Depreciation	350,000	350,000
Balance	*$3,143,427	$3,083,547
Preferred dividends	677,026	677,026
Common dividends	1,654,958	1,067,364
Surplus	$ 811,443	$1,339,157

*After preferred dividends, earnings on the $34,907,500 dividend bearing common stock were equal to $7.06 a share, against $8.18 a share earned in 1916 on $29,407,500 dividend bearing common stock.

The consolidated balance sheet of the Montana Power Company, as of December 31, 1917, compares as follows:

Assets.

	1917.	1916.
Property	$91,807,108	$87,984,609
Materials and supplies	503,207	374,941
Liberty Loan, 4% bonds	461,250	.....
Accounts and notes receivable	916,713	799,205
Cash	1,454,845	298,952
Sinking fund deposits	30,915	34,962
Deferred charges	2,503,776	2,547,098
Total	$97,677,815	$92,039,770

Liabilities.

Preferred stock	$ 9,671,800	$ 9,671,800
Common stock	*49,407,500	49,407,500
Funded debt	28,310,000	27,538,000
Bills payable	3,790,000	425 000
Accounts payable	684,488	442,496
Accrued interest	574,117	514,029
Dividends payable	605,600	463,331
Reserves	1,410,899	1,178,261
Surplus	3,223,410	2,399,770
Total	$97,677,815	$92,039,770

*Of the $49,407,500 common stock, $14,500,000 was not dividend bearing as of December 31, 1917.

Byllesby Business Shows Gain.

All electric properties of H. M. Byllesby & Company reporting for the week ended February 23 shows the following new business gains: 441 customers with 248 kilowatts of lighting and 1,074 horsepower in motors. New business contracted for, but not yet connected, includes 852 customers with 285 kilowatts of lighting and 1,322 horsepower in motors. Electric energy output shows a gain of 18.6 per cent compared with the corresponding week last year.

Public Utility Situation Shows Improvement.

The public utility situation is gradually turning for the better. A compilation of the annual reports of ninety-three of the principal corporations for the year ended December 31 shows aggregate net earnings of $207,761,420, as compared to $192,761,420 in the previous year.

The improvement in the average and the aggregate is largely due to the fact that state and municipal boards having the power of rate regulation have adopted a new policy toward the utilities and recognize the fact that the welfare of the nation at war depends in a large measure on the good credit and operating efficiency of public utilities.

The net earnings cited are after excess profits and income taxes have been charged off. Dividends in the average are no higher than in 1916. The excess of earnings has gone into extensions and improvements to add to the equity behind securities.

A majority of the rate increases granted came too late in the year to be fully reflected in 1917 earnings. The prospect for 1918 is encouraging to investors. The federal government is taking an active interest in the utility situation and the attention of state and municipal ratemaking bodies has been called to the statement of the president which concluded:

"It is essential that the utilities should be maintained at their maximum efficiency and that everything reasonably possible should be done with that end in view. I hope that state and local authorities, where they have not already done so, will, when the facts are properly laid before them, respond promptly to the necessities of the situation."

Power Company Makes Good Showing.

For January and for the 12 months just closed, the Pacific Power & Light Company, Portland, Ore., made a good showing of net earnings. The net for January was 33 per cent, the operating expenses gained only 5 per cent and the gross revenues increased 17 per cent over the same months of last year. For the 12 months, the net earnings were greater by 22 per cent, the operating expenses 3 per cent and the gross revenues 13 per cent higher than the corresponding period. Following are the figures:

	January, 1918.	12 months.
Gross revenue	$153,062	$1,166,773
Operating expenses	71,783	785,864
Net earnings	$ 81,279	$ 883,909
Balance after deducting all fixed charges.	45,081	447,045

Dividends.

Republic Railway & Light Company has declared the regular quarterly dividend of 1 per cent on common stock and 1½ per cent on preferred stock, payable April 15 to stock of record March 30.

Kansas Gas & Electric Company has declared a quarterly dividend of 1½ per cent on preferred stock, payable April 1 to stock of record March 23.

American Power & Light Company has declared a quarterly dividend of 1½ per cent, payable April 1 to stock of record of March 20.

Yadkin River Power Company has declared a quarterly dividend of 1¾ per cent on preferred stock, payable April 1 to stock of record March 15.

Carolina Power & Light Company has declared a quarterly dividend of 1¾ per cent on preferred stock, payable April 1 to stock of record March 15.

Pacific Telephone & Telegraph Company has declared a quarterly dividend of 1¼ per cent on preferred stock, payable April 15 to stock of record March 31.

Asheville Power & Light Company has declared a quarterly dividend of 1¾ per cent on preferred stock, payable April 1 to stock of record March 15.

Nevada Consolidated Copper Company has declared for the quarter ending March 31, 1918, a dividend of $1.00 per share, payable March 30 to stock of record March 9.

American Gas & Electric Company has declared a quarterly dividend of 1½ per cent on preferred stock, payable May 1 to stockholders of record April 18; also a quarterly dividend of 2½ per cent on common stock, payable April 1 to stock of record March 20.

Union Traction Company has declared a quarterly dividend of 1¼ per cent, payable April 1 to stock of record March 19.

Duluth Edison Electric Company has declared a quarterly dividend of 1½ per cent, payable April 30 to stock of record March 21.

Utah Power & Light Company has decared a quarterly dividend of 1¾ per cent on its preferred stock, payable April 1 to stock of record March 16.

Central Illinois Public Service Company has declared a quarterly dividend of 1½ per cent, payable April 15 to stockholders of record March 30.

Shawinigan Water & Power Company has declared a quarterly dividend of 1¾ per cent, payable April 10 to stock of record March 28.

Cleveland Electric Illuminating Company has declared a quarterly dividend of 2 per cent, payable April 15 to stock of record April 1; also a quarterly dividend of 1½ per cent on preferred stock, payable May 1 to stock of record April 25.

Duquesne Light Company has declared a quarterly dividend of 1¾ per cent on its preferred stock, payable May 1 to stock of record April 1.

Carolina Power & Light Company has declared a quarterly dividend of 1¾ per cent on preferred stock, payable April 1 to stockholders of record March 15.

Asheville Power & Light Company has declared a quarterly dividend of 1¾ per cent on preferred stock, payable April 1 to stock of record March 15.

The Electric Storage Battery Company has declared a dividend of $1 per share from the net earnings of the company on both preferred and common stocks, payable April 1 to stock of record March 18.

Iron Cap Copper Company has declared a dividend of 25 cents per share on the common stock, payable April 1 to stock of record March 20.

Manila Electric Railroad & Lighting Corporation has declared a quarterly dividend of $1.50, payable April 1 to stock of record March 19.

Ottawa Light, Heat & Power Company has declared a quarterly dividend of 1½ per cent, payable April 1 to stock of record March 20.

Earnings.

CUMBERLAND TELEPHONE & TELEGRAPH COMPANY.

Income account of the Cumberland Telephone & Telegraph Company for the year ended December 31, 1917, compares with the previous year as follows:

	1917.	1916.
Operating revenue	$9,219,954	$8,485,199
Net after taxes and interest	2,379,936	2,263,264
Dividends	664,809	664,809
Surplus	370,086	325,936

WISCONSIN EDISON COMPANY.

For the year ended December 31:

	1917.	1916.
Gross earnings	$1,446,411	$1,430,880
Net after taxes	*829,035	971,620
Surplus after dividends	184,035	57,870

*Equal to $3.85 a share on 215,000 shares capital stock, no par value, compared with $4.52 a share in 1916.

Niagara Falls Power Company

Income account of the Niagara Falls Power Company and the Canadian Niagara Power Company, for year ended December 31, 1917, compares as follows:

	1917.	1916.
Total operating revenue	$3,225,115	$3,062,836
Net operating revenue	2,017,229	2,210,939
Net income	2,195,805	2,365,815
Surplus after charges	1,200,065	1,362,116

While greater production and sales of power resulted in an increase of $162,279 in the gross of Niagara Falls Power Company, for the year ended December 31, 1917, this was more than offset by higher operating costs and taxes. The balance sheet shows that taxes alone more than quadrupled. There was added to surplus after all charges $1,200,065, compared with $1,362,116 in 1916, a decrease of $162,052.

Niagara Falls Power Company, the pioneer in the production of hydro-electric energy, was one of the three power plants at Niagara Falls whose output was requisitioned by the Government last December. Under the terms of the order, some of the company's customers of long standing were deprived of power, while others doing war work received a larger amount to meet increased demands.

COLUMBIA GAS & ELECTRIC COMPANY.

For the year ended December 31—

	1917.	1916.
Gross earnings	$10,861,840	$9,058,252
Net after taxes	5,222,073	4,334,476
Other income	1,948,614	827,602
Total income	7,170,687	5,262,078
Surplus after charges	2,934,485	1,157,476

WISCONSIN-MINNESOTA LIGHT & POWER COMPANY.

	1917.	1916.
Gross earnings	$ 1,712,220	$ 1,304,460
Net earnings	896,479	698,149
Interest	298,861	.....
Preferred dividend	291,200	.....
Surplus	306,418	.....

REPUBLIC RAILWAY & LIGHT COMPANY.

The Republic Railway & Light Company reports for December and twelve months as follows:

For month of December—

	1917.	1916.
Gross earnings	$ 492,941	$ 373,412
Operating expenses, depreciation and taxes	359,716	223,728
Net earnings	$ 133,224	$ 149,683
Other income	10,474	5,028
Gross income	$ 143,699	$ 154,712
Interest, subsidiary companies' dividends	92,201	81,746
Net income	$ 51,497	$ 72,965
Preferred dividends	25,957	25,957
Balance	$ 25,540	$ 47,008

Twelve months ended December 31—

Gross earnings	$4,889,915	$3,987,616
Operating expenses, depreciation and taxes	3,341,183	2,327,406
Net earnings	$1,548,732	$1,660,209
Other income	67,205	20,965
Gross income	$1,615,938	$1,681,175
Interest and subsidiary companies' dividends	1,004,426	827,569
Net income	$ 611,511	$ 853,606
Preferred dividends	311,484	311,484
Balance	$ 300,027	$ 542,122

DAYTON POWER & LIGHT COMPANY.

	1918	1917
January gross	$ 195,477	$ 177,570
Net after taxes	54,119	63,346
Surplus after charges	21,684	37,080
12 months' gross	1,898,525	1,652,969
Net after taxes	615,180	614,522
Surplus after charges	303,032	370,052

WEEKLY COMPARISONS OF CLOSING BID PRICES OF SECURITIES OF LEADING ELECTRICAL COMPANIES.

Quotations furnished by F. M. Zeiler & Co., Rookery Bldg., Chicago.

Public Utilities—	Div. rate. Per cent.	Bid. Mar. 12.	Bid Mar. 19.
Adirondack Electric Power of Glens Falls, common	6	16	16
Adirondack Electric Power of Glens Falls, preferred	6	72½	72
American Gas & Electric of New York, common	10+extra	90	90
American Gas & Electric of New York, preferred	6	40	40
American Light & Traction of New York, common	..	208	207
American Light & Traction of New York, preferred	6	96	96½
American Power & Light of New York, common	4	46	45
American Power & Light of New York, preferred	6	75	75
American Public Utilities of Grand Rapids, common	..	20	20
American Public Utilities of Grand Rapids, preferred	6	53	54
American Telephone & Telegraph of New York	..	105⅞	99½
American Water Works & Elec. of New York, common	..	4¾	4¾
American Water Works & Elec. of New York, particip	7	12½	12½
American Water Works & Elec. of New York, first preferred	..	59	49
Appalachian Power of Bluefield, common	..	2¼	2¼
Appalachian Power of Bluefield, preferred	7	20	20
Cities Service of New York, common	+extra	200	205
Cities Service of New York, preferred	6	74½	74¼
Commonwealth Edison of Chicago	8	106	106½
Comm. Power, Railway & Light of Jackson, common	..	23	24
Comm. Power, Railway & Light of Jackson, preferred	6	49½	49½
Federal Light & Traction of New York, common	..	5	6
Federal Light & Traction of New York, preferred	..	27	28
Illinois Northern Utilities of Dixon	6	..	..
Middle West Utilities of Chicago, common	2+extra	26	26
Middle West Utilities of Chicago, preferred	6	58½	60
Northern States Power of Chicago, common	ex.div.7	60	60
Northern States Power of Chicago, preferred	ex.div.7	87	87
Pacific Gas & Electric of San Francisco, common	..	36½	36
Pacific Gas & Electric of San Francisco, preferred	6	82	82
Public Service of Northern Illinois, Chicago, common	7	75	76¼
Public Service of Northern Illinois, Chicago, preferred	6	85	83
Republic Railway & Light of Youngstown, common	4	22½	22½
Republic Railway & Light of Youngstown, preferred	6	58	59
Standard Gas & Electric of Chicago, common	..	6	6
Standard Gas & Electric of Chicago, preferred	6	24	24
Tennessee Railway, Light & Power of Chattanooga, common	..	2½	2½
Tennessee Railway, Light & Power of Chattanooga, preferred	6	8	8
United Light & Railways of Grand Rapids, common	4	27	29
United Light & Railways of Grand Rapids, preferred	6	62	62½
Western Power of San Francisco, common	..	13	13
Western Power of San Francisco, preferred	6	49	49
Western Union Telegraph of New York	extra	89¾	92¼
Industrials—			
Electric Storage of Philadelphia, common	4	49¼	49
General Electric of Schenectady	8	139¼	138
National Carbon of Cleveland, preferred	8	56¼	56¼
National Carbon of Cleveland, common	..	130¾	130¾
Westinghouse Electric & Mfg. of Pittsburgh, common	+extra	41¾	41
Westinghouse Electric & Mfg. of Pittsburgh, preferred	7	63	59

*Last sale.